February 28, 1924

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Engineering News-Record

Study of Precipitation and Runoff Near the Continental Divide

Construction Methods on the Rochester Subway

Plan for Industrial Community of Alcoa, Tennessee

Transmission Line Work Aided by Aerial Survey

Transforming Erie Canal into Subway, Rochester, New York

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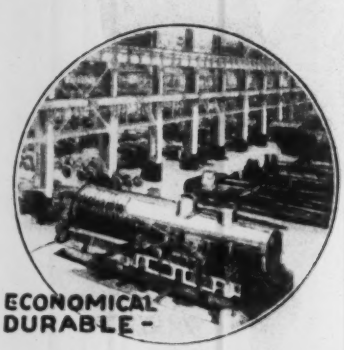

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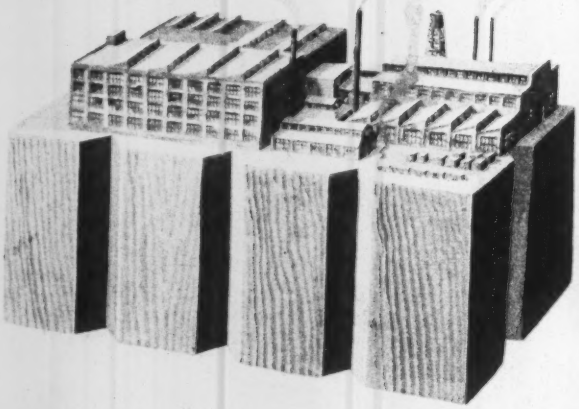

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FRANK C. WIGHT
Editor

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Good Publicity Work

ENGINEERING owes a compliment to the engineers of the Miami Conservancy District for the completeness and accuracy with which they are recording technically its important flood protection works in process of construction since 1918. Besides the volumes of technical reports the tenth and last of which is in preparation there have been placed in the archives of the Conservancy District 400 correct drawings of all the flood structures, over 4,000 photograph negatives of the work in progress and bound volumes of prints of these negatives. The record makes available to engineers everything of importance on the design and construction history of the largest purely flood control project in America. Search reveals only a few large works, either public or private, whose engineering history has been so thoroughly recorded. It is perhaps not amiss, in noting this service of the Conservancy District engineers to engineering, to note that they are excellently serving themselves.

A Breakdown in Individualism

LAST week New York had a heavy rainstorm hard upon a six-inch snowfall. The municipal snow removal forces failed to mobilize and for a full working day the citizens of our greatest city suffered the inconveniences of a border town. So long as one confined his wanderings to circumnavigating a block all was well but crossing a street involved perilous adventures in slush filled gutters deceptively solid with snow but shoe topping in liquid content. In other words, the citizen occupant of house and store assumed responsibility for clearing his sidewalk but because gutter and crossing clearing has become the duty of the municipality, he metaphorically washed his hands of them. If the city fell down, let the citizen suffer. And yet most of the discomfort of Wednesday week would have been avoided had each property owner and tenant taken it upon himself to clear the short stretch of gutter in front of his own property—a twenty-minute job. In our growing dependence upon government we lose a very precious sense of individual responsibility.

Safety Through Maintenance

HOW vital a relation careful maintenance bears to the safety of structures has again been emphasized by a failure, the fatal accident on a Pittsburgh bridge described in our issue of Feb. 14, p. 274. It was testified at the Coroner's inquest last week that the bridge was only thirty years old. On the score of age and original strength it would have been entirely safe. But apparently there was some doubt as to the ownership of the structure which made it uncertain whether the city or a railroad company should maintain it, and in this doubt maintenance was neglected. The doubt and the neglect were particularly serious because of the aggravated corrosion condition prevailing on the structure on account of its large livestock traffic, which made the floor drainage actively destructive to the floor steel. It was testified that the floor had been examined and repaired less than two years ago; yet since that time the floor has become so weak that a truck broke through one of the floorbeams. It is true that the rapid deterioration is chargeable to faulty design of the floor, which allowed the corrosive drainage to reach the steel. However, this condition was known, and it made maintenance only the more important. All structures require inspection and maintenance if their continued safety is to be assured. Bridges, being exposed to the weather, are much more urgently in need of maintenance care than other structures.

Ontario and Massachusetts

THE Province of Ontario seems to lead not only the other Canadian provinces but also any state this side of the border in the number of activated-sludge plants installed for sewage treatment. True, the seven municipal and eleven institutional plants listed elsewhere in this issue as already in use are small, but four municipal plants of larger size are projected for immediate construction. That eleven Ontario cities and towns have built or are about to build activated-sludge plants is significant of faith in the process by the engineers and municipalities of at least one Canadian province and also by the Ontario Provincial Board of Health. Presumably confidence in this process rests largely upon investigations made at the water and sewage experimental station of the board completed in 1909 and operated since under the direction of the Sanitary Engineering Division of the board. Well operated stations of this kind pay. In the United States, Massachusetts set the example by establishing its well known water and sewage experiment station more than 35 years ago, a station continued in useful service ever since, and one at which the activated-sludge process had its inception. It has remained for a Canadian province to follow the example of Massachusetts in the establishment of a sewage testing station and to go beyond Massachusetts or any other American state or Canadian province in the direct encouragement of the adoption of the activated-sludge process.

Low Bids for Roadwork

HIGHWAY contractors began the construction season of 1923 by bidding too low. The sad experience of loss, or at least of no profit, from their operations, it would seem, should have warned them against repeating the error. Yet there are clear indications that the old urge "to get in on the first letting" is creating a disposition again to take chances on prices for which there is no sound reason. With quite as much road construction in prospect as there was in

1923, will contractors again underbid their opportunity? They have no one but themselves to blame if they do. The sacrifice of contractors to construct improved roads is required by no one. Indeed state highway administrations are as far as they may, sounding a warning against contractors offering themselves as a sacrifice. Last week in addressing the New York State Highway Contractors' Association, Frederick Stuart Greene, State Superintendent of Public Works, announced that the state this year would let contracts in the amount of some $30,000,000 and expressed the hope that "the contractors would make money." He urged against bids too low for a profit. He said: "You bid 75c. a cubic yard for excavation, and it cannot be done at that figure. The state engineers estimate $1.25 a cubic yard. It can be done for $1 a cubic yard at a small profit, but the extra 25c. gives the contractor some leeway." Privately other state highway engineers, it is known, have given similar warnings. There may be exceptions, but, by and large, it is contractors and no one else who are responsible for the underpricing of road work. Theirs is the duty to reform the practice.

Ground Surveying's Complement

FEW BETTER explanations of the manner in which aerial surveys may aid ground work are offered the engineer and surveyor than appears this week in the article on transmission-line construction in Pennsylvania. Disposition on the part of engineers to believe the airplane in engineering is but an innovation should be dispelled by the detailed article referred to. Where economically usable, the airplane camera has justified itself as a complement of the transit. Reconnaissance that may arouse property holders to a point where locating becomes more than surveying or engineering is accomplished in a few hours. Extensive preliminary work and in fact initial location are possible in days instead of weeks. And by supplementing ground work with information gained from the air the minimum of destruction to property and thereby small cost in securing right-of-way is made possible. Aside from the technical complementation offered the surveyor by the airplane photographs, they have popular uses, such as entertaining obstinate landholders while rights-of-way are sought, an obvious improvement over the old method of letting the farmer's son carry the transit. The article is allowed to run in detail so that every engineer and surveyor may be fully informed as to the adaptability aerial surveys may have for his specific job.

Planned Cities

MOST cities have not realized that there is such a thing as city planning until after decades or centuries of existence. Far too late the awakened community resorts to unsatisfactory and costly replanning to remedy evils which planning might have prevented or if not wholly prevented then lessened in large degree. Planning is easier said than done. Most cities happen. Deliberate and intelligent city planning cannot be expected without an organized purpose backed by money and power to see that the purpose is accomplished. Without outlining the various possibilities of achieving such a combination it may be said that one of them may be effected through the industrial town, promoted and controlled by a single industry or a group of more or less closely related industries. An example is afforded by Alcoa, Tenn., the plan of which is presented elsewhere in this issue. The future will bring many such opportunities as was seized at Alcoa. They will present themselves both where the virgin resources of nature—lumber, minerals, etc.—are being utilized and where manufacturing communities are springing up through the decentralization of both industry and population that is now going on and deserves encouragement. Rarely does it happen that the engineer is not called upon for the major part of the detailed planning of the industrial plants around which these new communities center. He should concern himself also with the town-planning opportunities thus afforded, contributing alike to the civic and social as well as the industrial upbuilding of the country and of this century of progress.

Cross-Connections and Typhoid Again

RELATIVES, heirs and administrators of estates of typhoid victims in Fort Wayne, Ind., are suing the city and the Pennsylvania Railroad for money damages. About $65,000 is the aggregate sum asked for. Chances for collection are, perhaps, better than they would be in Chicago, since $50,000 was paid out seventeen years ago in Fort Wayne in similar cases. The allegations in the present complaints set out that the city permitted the railroad company to connect its private water mains with those of the city, and that a faulty valve permitted the polluted river water to enter the city mains.

More than 150 cases and 22 deaths from typhoid occurred from an explosive outbreak last November and early December. The cases were confined to a small area near the Pennsylvania Railroad yards. Whether or not the gate valves either side of the check were found open or the check valve faulty is beside the point. The connection certainly was made to be used and the danger therefrom was potential. The victims have not died in vain nor the patients who got well suffered without result, for the State Board of Health, Jan. 9, adopted a rule prohibiting such connections after June 1 "regardless of whatever mechanical or supervisory safeguards may be adopted." Promulgation of a rule by the State Board of Health in Indiana has the force of law and carries the penalties already defined by law.

So much for Indiana, but while we write comes a report from the Wisconsin State Board of Health for the last quarter of 1923 in which a typhoid epidemic in a factory in Wausau was traced to the same vicious cross-connection practice. In 1920 the Wisconsin officials recommended the elimination of this very connection. Although the report states that similar outbreaks have occurred on numerous occasions in Wisconsin, only a moderate scolding is given to other factory owners whose building safety is placed above human life. Apparently the Wisconsin law lacks teeth. The admonition is as follows: "It therefore behooves public water-supply officials to see that all such connections are entirely eliminated or properly protected by double check valves of a type approved by the State Board of Health."

Substantial backing has been given to the Indiana officials by the insurance interests, who hold that no rate reductions can be given factories through law violations

Just how close the Chicago epidemic in November (see *Engineering News-Record*, Jan. 17, p. 116) due in all probability to direct contamination (Lake Michigan

acting as the cross-connection or mixing vat) comes to criminal negligence, the courts would soon determine should some one of the heirs of the sixteen Chicago victims press the matter. From the scientific standpoint, the negligence consists largely in not knowing enough about the supply analytically to apply the necessary amount of germicide. This phase of negligence has been guarded against by the employment of a sanitary engineer whose sole business it is to ascertain bacterial content, interpret results, and then see that orders regulating chlorine dosage are carried out. Responsibility is still so much divided between different officials in Chicago that the old army game of "passing the buck" would be indulged in to the limit should heirs of future epidemics, predicted by the health authorities, attempt to fix legal responsibility for death. One might almost infer that the divided-responsibility condition has been maintained as the safest way to guard the taxpayer's money from the results of damage suits.

When the Bloomington cross-connection case (see *Engineering News-Record*, May 13, 1920, p. 939) came up it was stated editorially that there was no need to look in the news columns for any further account. Just so in the Indiana and Wisconsin cases. Further details are so simple and usual as to be entirely unnecessary.

Hartford and Stamford, Conn., Lowell and Springfield, Mass., Philadelphia, Cleveland, Terre Haute, Ind., St. Paul, Minn., all prohibit the cross-connection menace. The Minnesota State Board of Health does not permit any cross-connections and the Illinois State Board of Health prohibits new ones. The remedy for the cross-connection nuisance needs for description but three good old Anglo-Saxon words, **cut it out.**

Detail in Building Codes

SHOULD building codes specify the details of design and construction? A correspondent criticizes a building code now being considered for adoption, on the ground that it does not prescribe details such as mixture of concrete and tests for sand and water. He claims that unsafe building will result if these elements of construction method are not prescribed. The point raised is old, but it has taken on a new aspect with the modern tendencies toward increasing elaborateness of building codes and standards. Essentially it is this: Does sound construction depend on the exercise of professional knowledge and skill, or on prescribing the details of the work by law?

The opposing views concerning this question have strong partisans. At present those who favor detail rules appear to be in the majority. There has been a steady movement toward the elaboration of the simple codes of earlier days into complete specifications. Not only arrangement, loads and stresses are laid down, but in addition rules for calculation and proportioning to a degree savoring of the engineer's professional handbook, and efforts are constantly being made to secure the insertion of further restrictions, in favor of some one practice, material or type. Even the simplest code of a small city is now an elaborate document, as intricate as the law of domestic relations and equally hard to understand.

Quite recently, however, the beginning of an opposite drift has been noticeable. The merits of simple codes embodying only fundamental principles are coming to receive more attention, and the effectiveness of detailed codes is under challenge.

The case for the two kinds of building code may be indicated briefly. For the detail code it is urged that, its purpose being to require good design and construction, a definition of good design and construction must be given; that if plate girders in buildings are to be made safe, a mere statement of working stresses will not suffice, but the limiting web thickness and rivet and stiffener spacing must be prescribed. Further, that while a good designer can be depended upon for these details, much work is done by other than good designers, or under the pressure of competition for cheap design. In the modern tendency of codes the intent seems to be to make them as nearly as possible foolproof and capable of application by even simple, untrained minds. The designer is to be estopped from arbitrary variation and limited to applying routine calculation. The same is to be done for the constructor, though this part of building codes has remained decidedly weak.

For the code of general character it is argued that the details of professional practice need not be specified because the capable designer knows them, and that they cannot satisfactorily be specified, because they are too numerous and each may take many forms. The demands of public safety may be met by fixing safety factors for the calculable elements of the work, and in the case of those elements which depend on mass experience rather than analysis—such as exit facilities or window or ventilation provisions—setting minimum limits. For the rest the designer's judgment and power of original planning should have free scope, in the interests of safety and economy. Thus the man who directs the work determines the result and is responsible for it; and obviously it is presupposed that he is competent.

Much might be said for either of these two views. But it is plain that at bottom the one relies on obtaining sound construction through competent and trustworthy men, while the other hopes to obtain satisfactory results even without such men. In this light we believe that the ultimate verdict will be in favor of the simple code of fundamental principles, to be applied by competent designers and builders.

Practical experience is the touchstone, rather than opinion. Have detail building codes raised the level of building practice? There has been a general advance in the quality of building, parallel to the advance in industry generally, but the present question is what advance has been brought about through building codes. Has the field of building been opened to less competent men and the difficulty of obtaining sound construction been increased rather than diminished? Questions of this kind should dictate the choice.

It will always be true that good construction, as a field of specialized skill, depends on the ability of the men engaged in it—on the skill of architects, engineers and craftsmen. This basic truth is to be kept in mind in considering the function of building codes. It seems clear that the straight course toward sound building is to place the work in the hands of competent men and squarely charge them with the responsibility for a good result. Building codes are useful only as they aid in this purpose. They may appear to give added assurance, by hedging the builder about with restrictions to supply any deficiency in his competence and integrity, but this assurance has not yet demonstrated its reality.

Construction Methods on the Rochester Subway

In Converting Old Erie Canal Bed for Passenger Subway, Line Drilling Economic Substitute for Channeling—Dry Batch Haulage to Mixing and Chuting Plant on Car

USING a number of methods which are novel and have proved to be also economical, the construction task of converting the old Erie Canal in Rochester, N. Y., into a subway whose roof forms a paved boulevard, is nearing completion in its principal construction elements. This year will see all the work finished on the main contract let in April, 1922. Then the city will have a mile of new boulevard and a four-track subway in its very center and including the old canal aqueduct which crossed the Genesee River. The structure is indicated by the transverse sections shown in Fig. 1 and the plan shown in Fig. 2. The scope and purpose of the improvement in general were outlined in *Engineering News-Record*, May 4, 1922, p. 744, and the present account is confined to the construction problems and methods.

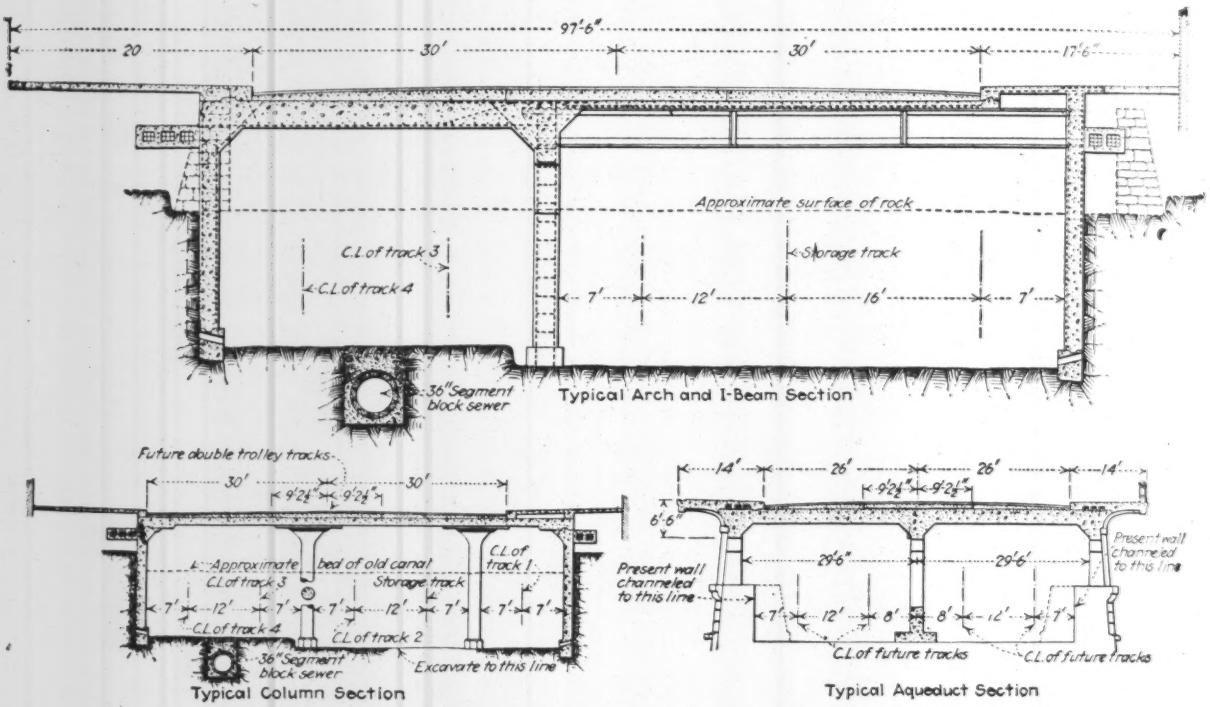

FIG. 1—TYPICAL SECTIONS OF SUBWAY STRUCTURE

General Conditions—Throughout the improved section, the old canal was bordered closely by buildings some of which were of considerable size and some of which were in not too sound a condition structurally. This situation is indicated in some of the accompanying views. On each side of the channel was a rubble masonry retaining wall founded on ledge which generally was just below canal bottom. One of the sections in Fig. 1 indicates the old canal structure. To provide for the planned subway structure (Figs. 1 and 2) the old channel had to be widened in most places by at least the full thickness of the retaining walls. With buildings close to the channel this widening brought into the construction problem the consideration of possible building settlement or failure. There was also deepening to complicate the problem by possibility of undermining and by the shock of blasting. To provide head room for cars with the subway roof at approximately street level the old canal had to be deepened, the cut ranging from zero to about 14 ft.

Crossing the channel at street intersections were bridges, water mains and electric conduits. Traffic had to be maintained. The water and gas mains had to be lowered below the elevation of subgrade and the conduits replaced by new ones located in the concrete slab of the finished structure. On some of the bridges, the movement of street traffic—street-cars, vehicles and pedestrians—was constant, and interfered with both excavation and the concrete construction. Two of the principal bridges had to be raised in order to carry on the work.

The preceding statements refer only to the channel in earth and rock. Across the Genesee River there was an aqueduct of massive and remarkably good ashlar masonry. Like the prism in earth and rock, the trough of this aqueduct had to be widened, it could not of course be deepened. Also at the east end one wall had to be flared outward to flatten the bend in the old channel which the subway lines follow. Fig. 3 indicates this widening-out of the structure and also shows the concrete superstructure erected on the old stone walls to continue the boulevard across the river and to a connection into South Ave., one of the notable thoroughfares of the city.

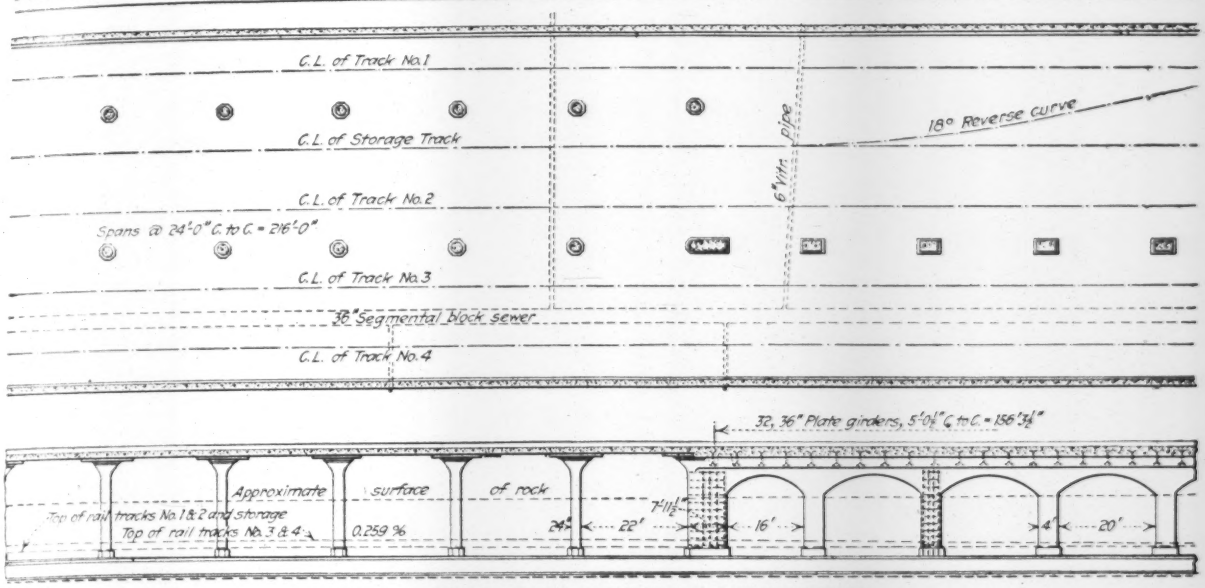

FIG. 2—TYPICAL PLAN OF SUBWAY IN EXCAVATION

These conditions imposed construction limitations. Practically no space existed alongside the channel—all the working room required had to be found within the cut. Also the close juxtaposition of business buildings to the construction and the constant business movement across the cut limited freedom of construction procedure to that which did not endanger property or persons or interrupt normal services required by business. All plant locations and all construction operations conform to these limitations.

There were two principal construction operations, excavation and building concrete structure. Of the concrete work there were two classes, normal subway structure and revamping the old Genesee Aqueduct into a double-deck viaduct.

Excavation Methods—About 110,000 cu.yd. of excavation were required to deepen and widen the canal cut. Of this 64,000 cu.yd. were ledge rock and the remainder was earth overburden including the old rubble masonry side walls. About one-third of the earth was required for backfilling behind the new subway walls and the remainder was wasted. The wasting was a truck haulage operation, the trucks being loaded by two small traction steam shovels.

The rock excavation was the more intricate task. The sides of the cut averaging 9½ ft. deep had to be left vertical often with building foundations close to the edge. Again blasting had to be done so as to safeguard property and people, and, since the rock was a limestone excellent for concrete, the drilling and blasting was manipulated so that the rock could be easily loaded into trucks and dumped directly into the crusher.

Line drilling was the method adopted to secure a vertical side cut. The holes were put down to subgrade from 3 to 6 in. apart with pneumatic hammers. A charge of 1 to 1½ lb. of 40 per cent dynamite was put into about every tenth hole. The cut was made square across the channel between rows of line holes and the full depth to subgrade. The bench holes were spaced 2 to 3 ft. on centers in both directions and were drilled to 18 in. below subgrade. The sketch Fig. 4 indicates the procedure in breaking out the cut and Fig. 5 is a view of the hammer gang working on bench holes.

For the reasons previously given, charging and firing sequence called for particular attention. Each bench hole was loaded and about every tenth line hole, which made the spacing of charges about uniform. The bench-hole charges were 2½ lb. each; they were generally split and the parts, each with a primer, were spaced at various elevations in the holes as the judgment of the blasting foreman told him would bring the best results with the local rock conditions. The holes were fired 18 to 26 at a time in the sequence of cuts indicated by the Roman numerals on Fig. 4. In firing, the blasts were

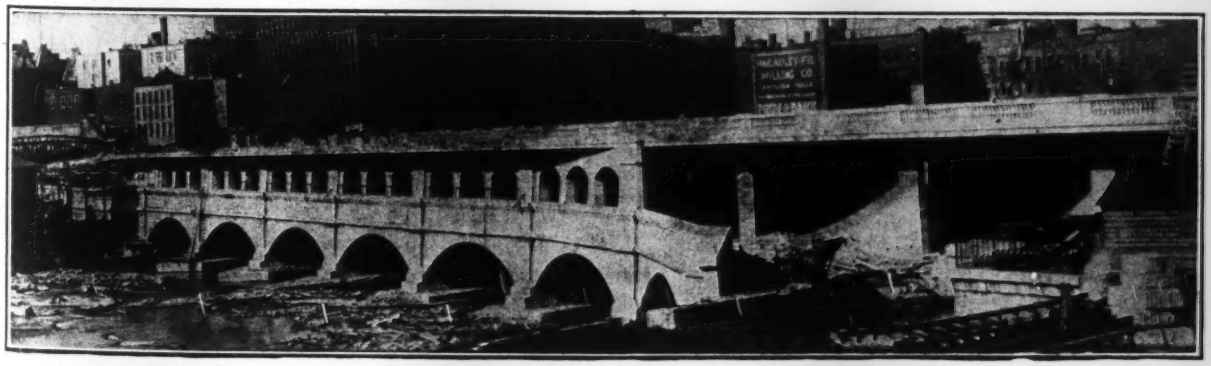

FIG. 3—SUBWAY STRUCTURE SURMOUNTING GENESEE RIVER AQUEDUCT

covered with mats and as shown in Fig. 8 the peak of the blast was seldom more than 4 or 6 ft. high. The shock was insignificant.

Little of the rock was broken too large for the crusher. Fig. 7 shows a blasted face with the steam shovel loading trucks which delivered the rock to the crushing plant. This had a No. 7 primary breaker and a No. 4 auxiliary crusher, with elevators, screens and bins, located at the west end of the work in the canal bed and adjacent was the proportioning plant for dry batch haulage to the concrete mixer. Air for drilling was supplied through a maximum of 1,700 ft. of pipe from a 16x24-in. compressor located at about the center of the excavation work. Practically all the rock was handled by one steam shovel, a 1½-cu.yd. revolving machine on crawler traction. The total of 64,000 cu.yd. was excavated in 13 months.

Substantially all the excavated rock was crushed to 1½ in. size and used as crusher-run aggregate, with the

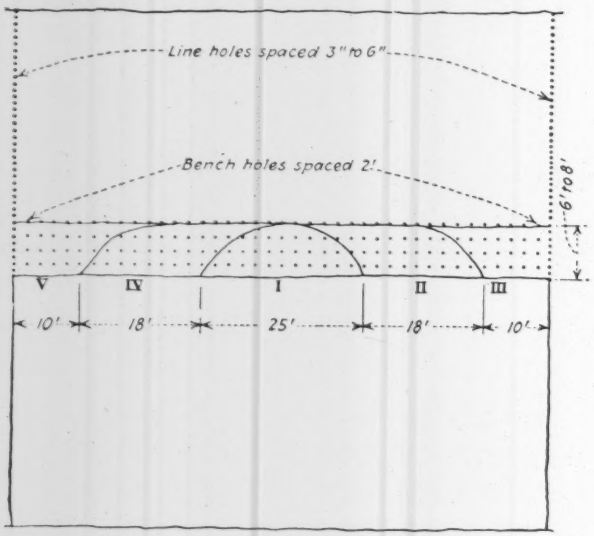

FIG. 4—PROCEDURE IN BREAKING OUT ROCK CUT

dust screened out, for the concrete, or was sold for local construction operations.

Concrete Subway Construction—Two of the sections, Fig. 1, and the plan, Fig. 2, show the concrete structure. It was a reinforced column, wall and floor job, which had to be carried on with plant and operations all within the canal cut. All transportation had to be along the bottom of the cut and concrete materials haulage and haulage of excavation had to go on at the same time over this one way—truck haulage of rock to the crushing plant and industrial railway haulage of dry batches from the crusher plant to the car-mounted mixer which also traveled along the cut bottom.

As previously stated, the proportioning plant is a part of the crushing plant installation. It consisted of three bins arranged as indicated by Fig. 6. Each bin had six measuring chutes. From these bins twelve dry batches were proportioned with four "spottings" of a six-car train. The procedure is indicated by the diagram Fig. 6, which shows the train at the second "spot." Each batch box held dry material for a 1-cu.yd. batch or 45 cu.ft. The six-car train was hauled on a 36-in. gage track by a six-ton gasoline locomotive. Fig. 11 shows a train at the mixer.

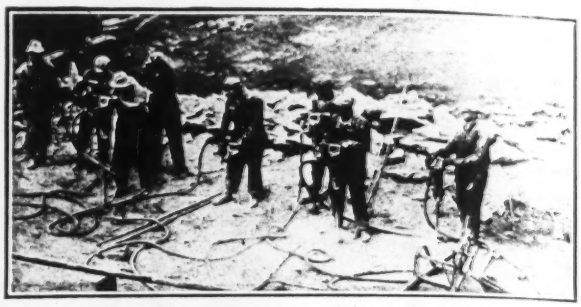

FIG. 5—HAMER GANG DRILLING BENCH HOLES

The dry batches go to a car-mounted mixing and chuting plant located where the concreting is in progress. The mixer car is 12x36 ft. with four 10-ft.-gage double-flange wheels. It is equipped with No. 28-S mixer, a 60-ft. hoist tower with 80-ft. chute radius and a stiff-leg derrick for handling batch boxes. As indicated by Fig. 11, the mixing plant builds the structure behind and each side of itself, the batch train movement being through or under the concreted structure.

Generally the sequence of concreting operations is as follows: (1) Wall and column footings were poured; (2) the side walls were poured up to 6 ft. 8 in. and the bent rods were placed; (3) the upper sections of side walls and the columns were poured to the underside of the deck; (4) and 12 hr. afterward the deck was poured. A section of structure 24 ft. longitudinally and full width was concreted and then the mixing plant was moved ahead for another section. These sections ran from center to center of spans so that the deck construction joints would come at mid-span. Deck sections averaged approximately 120 cu.yd. and were poured in 4 to 6 hr.

Generally the formwork was ordinary and only one fact calls for notice in the outfit used: The concreting plant with its 80-ft. chuting reach gave space for form erection between the mixing plant and the bay being poured. With the chuting outfit it was found necessary to move the tower and mixing plant immediately after each section was complete, so as not to interfere with form building. A portion of the concreted subway (column section) is shown by Fig. 9.

Genesee River Aqueduct Section—A separate plant installation was adopted for carrying on the task of remodeling the old masonry canal aqueduct shown nearly complete, as remodeled, by Fig. 3. A mixing

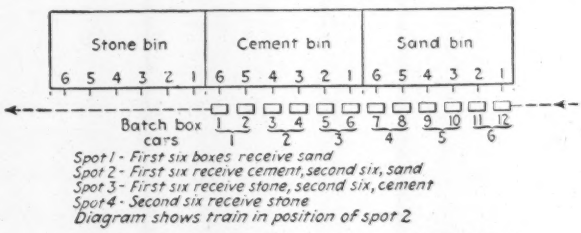

FIG. 6—DIAGRAM SHOWING PROPORTIONING PLANT PROCEDURE

plant was installed just south of the east end of the aqueduct and wet batches were taken out to the work by industrial trains and there placed by a traveling crane. Two main features of the working procedure are the operation of this crane and the widening of the old masonry aqueduct trough or channel.

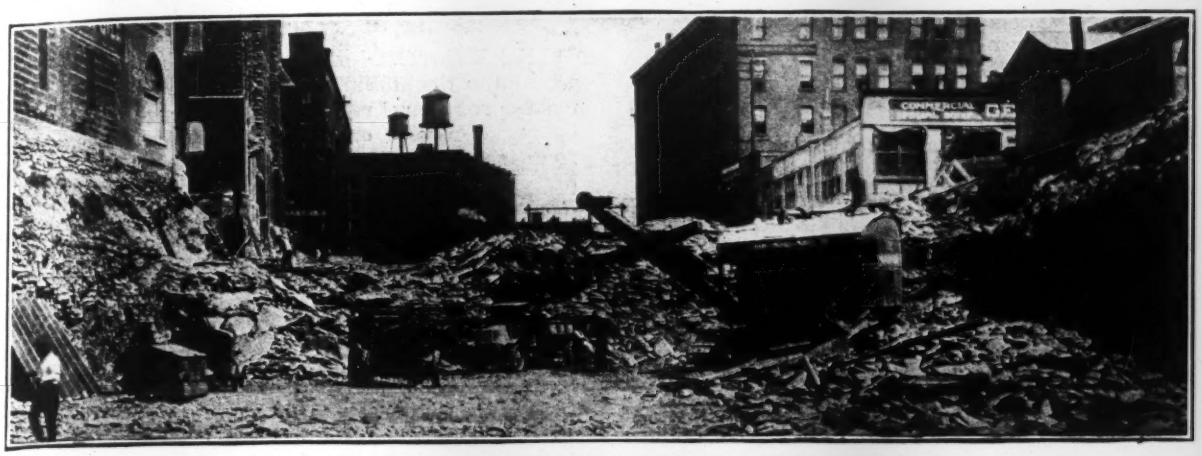

FIG. 7—BLASTED FACE WITH STEAM SHOVEL LOADING TRUCKS

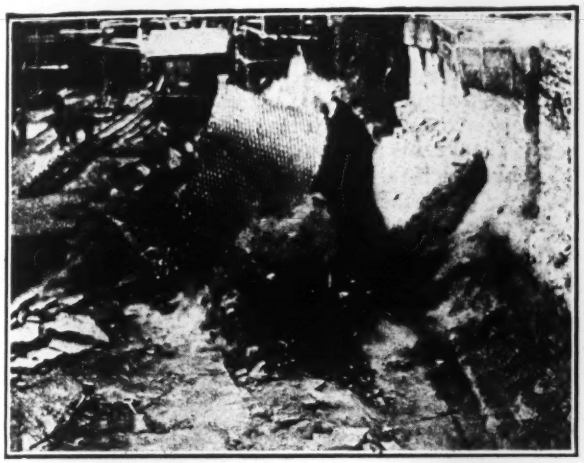

FIG. 8—TYPICAL BLAST IN ROCK CUT

Note the line holes 4 in. apart used instead of channeling machine cut. Also note control of blast the peak of which rises scarcely above the 8-ft. wall.

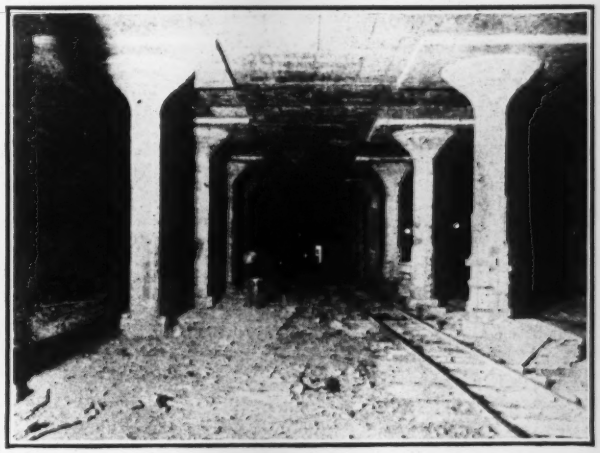

FIG. 9—INSIDE THE COMPLETED SUBWAY

Cylindrical columns with mushroom tops molded in steel forms. Wood forms made up in panels used for roof and side walls.

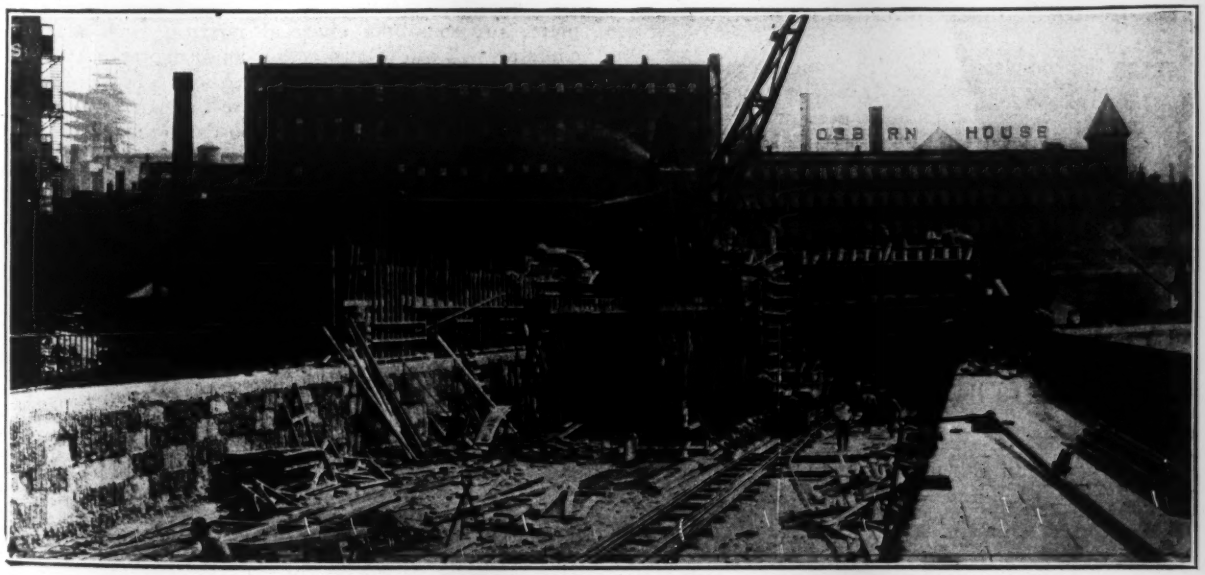

FIG. 10—CONCRETING STRUCTURE ON AQUEDUCT

An average of about 5 ft. of masonry side wall had to be trimmed from the inside of the aqueduct. It was planned to take off the 5 ft. strips by channeling machine cuts, but the contractor feared the shock to the masonry and the possibility that the chisel running into joints would bind and crowd the blocks loose and he therefore secured permission to substitute line drilling and wedging. The result was perhaps a rougher surface as indicated by Fig. 10, but as this is not visible except to people in the subway trains its objections are not considered important. Meanwhile there has been no visible disturbance of the remaining masonry by the quarrying methods followed.

As shown by Fig. 10 cars with concrete coming

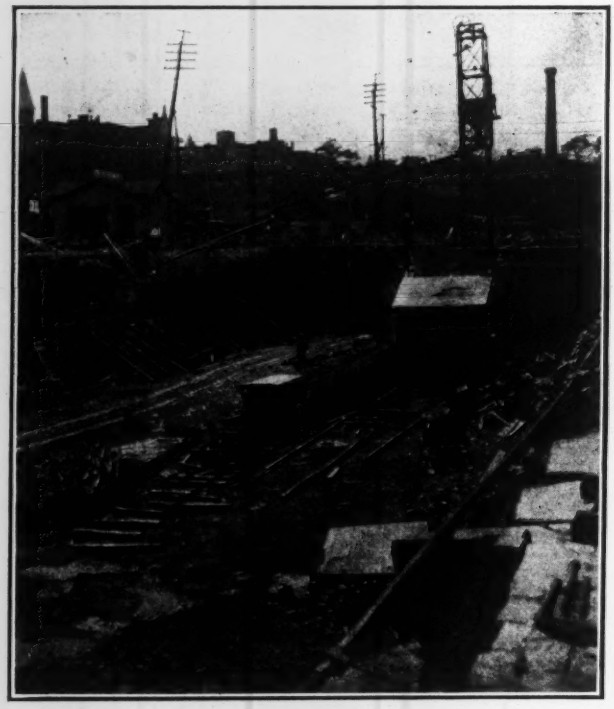

FIG. 11—CAR-MOUNTED MIXING AND CHUTING PLANT

through the completed structure from the mixing plant are unloaded by a revolving, traveling crane on trestle whose top level is just under the subway ceiling level. The crane has a capacity of 10 tons. It can therefore pick up a rear section of trestle and shift it ahead and the trestle is designed with this procedure in view. It consists of 10-ft. sections composed of two bents each, and is 16 ft. high. Each section weighs about 7 tons. Six sections were provided. This arrangement has worked excellently. Its chief objection is that scant room is left between the crane placement and the work being concreted, for form construction, but this was eliminated by the quick removal of short sections of trestle as soon as the concreting operation had been finished.

Organization—The construction described has been carried on under the general direction of the city engineering staff of Rochester at the head of which are C. Arthur Poole, city engineer; Edwin A. Fisher, city planning engineer; and John A. O'Connor, subway engineer. The contractor is Scott Brothers, of Rome, N. Y., with H. O. Bagley as superintendent in direct charge.

Gassing of Trackmen in Tunnels

THE RELATION of atmospheric conditions in tunnels to the difficulty and discomfort of track maintenance and tunnel repair has been brought to attention by recent reports on means of protecting enginemen from the combined effects of smoke, gases and extreme heat in long tunnels, as noted in *Engineering News-Record*, Aug. 16, 1923, p. 255. Investigation indicates that the conditions are rarely such as seriously to affect workmen in the tunnel, so that few attempts have been made to provide special protection. Where tunnel ventilating apparatus has been applied for operating reasons it also benefits the trackmen.

In the first place, the temperature in the refuges along the tunnel walls is probably 20 to 40 deg. lower than in the engine cab. Dilution of the gases also begins as soon as the engine has passed, while the smoke usually tends to travel along the roof of the tunnel and the air is soon comparatively clear in the lower portion. Men on scaffolds or repair cars may have to descend to the track and, where conditions are severe, lie face downward at the side of the tunnel, covering mouth and nose with a handkerchief to prevent inhaling gases.

In the second place, it is a general rule to require men to come out of the tunnel when trains are due and to stay out until the tunnel begins to clear of smoke. This necessarily delays the work, but it is doubtful if much or any time would be saved by men staying at work with the aid of gas masks, especially as the darkness and confined space always retard work in tunnels. The rule cannot always be followed, but the tunnel gang should be under the protection of flagmen on the approaches and train crews should be notified of tunnels in which extensive work is being carried on. On single track, a section with several tunnels or a long tunnel may be operated on the staff system. The staff would be given to the tunnel gang with instructions to be out at a given time in order to deliver the staff to a train and thus enable it to proceed.

Gas masks have been tried experimentally in a few cases but they are inconvenient and the men do not like them. One such device consists of a small canister hung from a neck strap and having a nose clip and mouthpiece. A soda-lime charcoal mixture packed in the canister will afford protection against smoke and irritating sulphurous gases, but a carbon-monoxide absorbent packing would be used where the carbon monoxide content of the air is likely to be dangerous. Inexperienced men sometimes suffer discomfort in tunnel work and may even have to be carried out, but no serious illness seems to result. The men soon become accustomed to working in the tunnel air and learn how to protect themselves when conditions become very bad.

Italian Plants Near 3,000,000 hp.

According to the report of the General Confederation of Italian Industries, Engineer Civita, at a meeting of the Italian Electrotechnical Association, gave the following interesting data regarding the hydro-electric situation in Italy. In 1915 the power generated by the central stations amounted to 1,520,000 hp.; in 1922 the figure was 2,170,000, or an increase of 55 per cent. The increase during 1921-22 amounted to 300,000 hp. In the near future large plants are to be built in Trentino, Venezia, which in three or four years will bring the total hydro-electric power up to 3,000,000 hp.

Precipitation and Runoff Near the Continental Divide

Study of Records for Basins Mostly at Elev. 9,000 Ft. on Both Slopes of Colorado Rockies Indicate That Orientation and Snowfall Largely Account for Greatest Runoff

By Robert E. Horton
Consulting Engineer, Albany, N. Y.

THE increasing demand for electric power and irrigation water where the larger, lower and more contiguous projects are mostly utilized directs attention to the runoff from the smaller mountain drainage areas, particularly in the Rocky Mountain region. Data regarding the yield of such basins are meagre. Available runoff records for a number of small high-lying Rocky Mountain areas have recently been compiled by Follansbee (Water Supply Paper No. 500, U. S. Geological Survey). The table, p. 357, gives selected records each covering a number of small basins near the continental divide in the Rocky Mountain Region of Colorado, where 90 per cent or more of the area drained lies above elevation 9,000 ft., and where the yearly runoff depth ranges from about 30 to 120 in. The locations of most of the drainage basins and the locations and elevations of some adjacent rainfall stations are shown by Fig. 1.

The relation of precipitation to runoff for these areas presents an interesting problem. The principal facts to be reconciled are as follows:

Thirteen basins draining west slope of continental divide:	
Mean elevation	10,318 ft.
Mean yield	102.0 in.
Mean precipitation (12 stations)	14.05 in.
Mean elevation of precipitation stations	6,905 ft.
Ratio yield to precipitation	7.26
Eight basins draining east slope of continental divide:	
Mean elevation	10,693 ft.
Mean yield	58.80 in.
Mean precipitation (15 stations)	21.01 in.
Mean elevation of precipitation stations	9,504 ft.
Ratio yield to precipitation	2.8

The source of the heavy runoff from these small high mountain basins is not only of great practical importance but it is a matter of scientific interest as well. Naturally this question has been answered in a superficial way heretofore by assuming that the rainfall increases with elevation. It is the purpose of this discussion to call attention to the fact that this explanation, while partly applicable, is incomplete and apparently inadequate.

Several of the rainfall stations on the western slope are closely adjacent to the continental divide, some are within the drainage basins under consideration and one, at Climax, is directly on the continental divide. Stations on the eastern slope are more remote and at generally lower elevations. It will be noted that the measured runoff on the western slope is more than seven times as great as the measured precipitation. The highest recorded amounts of precipitation at any stations in the region are:

	Elevation, Ft.	Precipitation, In.
West Slope		
Silverton	9,285	32.65
East Slope		
Manitou	9,320	31.30
Pikes Peak	14,111	29.55
Climax	11,304	36.11

The greatest precipitation for any one station is less than the least runoff for any one of the drainage basins shown by Fig. 1.

Taking group means, the relation of precipitation to elevation at stations adjacent to the west and east slopes bordering the continental divide has been determined and the results are shown by Fig. 2. The continental divide at the heads of the drainage basins shown on Fig. 1 is at an average elevation of about 12,500 ft. Extending the curves (Fig. 2) it appears that at this elevation on the east slope a precipitation of about 29 in. would be expected. On the west slope the increase of precipitation with elevation is much more rapid and at elevation 12,500 a precipitation of 46 in. would be expected. Thus from a consideration of increase of precipitation with elevation the existing data afford an indication of a maximum precipitation of 46 in. near the summit on the west slope of the continental divide to account for an average runoff of 102 in., and a precipitation of 29 in. on the east slope to account of a measured runoff of 58.80 inches.

Away from the continental divide on the Rocky Mountain plateau the relation between measured precipitation and runoff is in general consistent. For example, at Wagonwheel Gap (Supplement 17, *Monthly Weather Review*, 1922), average drainage basin elevation about 10,000 ft., seven years' records show (all in inches): Precipitation, 21, runoff, 6.08, and water losses, 14.92. Since the Wagonwheel Gap basin is at about the same average elevation as those along the continental divide the water losses in the latter case may fairly be assumed to be of the same order of magnitude. Thus to account for the measured runoff plus water losses from the west slope of the continental divide a precipitation of about 116 in. must be assumed, as compared with a maximum of 46 in. determined from existing rainfall data. On the east slope a precipitation of about 73 in. must be assumed, as compared with an apparent maximum of 29 in. Before attempting to reconcile these remarkable differences attention will be called to certain significant facts:

(1) The yield of basins draining the west slope of the continental divide is invariably greater than for adjacent basins draining the east slope. This is clearly shown by Fig. 1.

(2) The difference in mean yield between basins draining the west slope and basins at the same average elevation draining the east slope is more than can apparently be accounted for by the evident difference in precipitation at corresponding elevations on the two slopes.

(3) The west slope receives its precipitation mainly from winds blowing from the west and southwest. This precipitation at the highest levels is mostly in the form of snow. Close to the divide there is a diurnal mountain and valley wind blowing up the slope in the afternoon and a predominant wind from the west at all seasons. The precipitation is quite uniformly distributed throughout the year, the average amount falling in the summer months April to October, being about the same as the amount falling in the winter months.

(4) East of the continental divide, rainfall dis-

tribution is of the summer thunderstorm type. On an average only about one-third of the total precipitation falls during the winter months, November to March, inclusive. Winds passing over the divide from either direction produce little precipitation on the leeward side.

(5) Winds approaching the continental divide from the west and southwest must blow for hundreds of miles over the Rocky Mountain plateau, for which the dominant elevation is around 7,000 ft. These winds lose nearly all the moisture derived from the ocean which they originally contained in ascending to this plateau and the precipitation which they yield thereafter is apparently derived mainly from moisture picked up en route from evaporation.

(6) The general plateau extends at a more or less uniform elevation of about 7,000 ft. nearly to the continental divide, where a rise to El. 11,000 or 13,000 occurs within a distance of a comparatively few miles.

Owing to the high altitude, low temperature and aridity of the region crossed by these plateau winds it would at first appear that the amount of precipitation they could yield, even when subject to several thousand feet superelevation in crossing the continental divide, would be comparatively small. A simple illustration will show that this is not necessarily true. For example, suppose the amount of evaporation contributed to the air over the plateau is 0.10 in. per day and suppose that this is taken up by a wind traveling say 10 miles an hour, or about 250 miles a day. Under certain conditions all this moisture may be precipitated within a distance of a few miles. If the precipitation occurred over a belt 10 miles in width then the precipitation rate would be 2.5 in. per day.

It can be shown that under certain conditions the locus of condensation of an air current ascending a mountain slope may be very nearly a vertical line. This would be approximately true if the temperature of the air decreased adiabatically from the ground upward and the moisture content of the air decreased at the same rate. An approximation to this condition under circumstances such as those existing on the Rocky Mountain plateau west of the continental divide is by no means improbable. This would mean that there would be only a moderate increase of precipitation with elevation up to a certain height; then a sudden very large increase to a maximum would occur, after which with further ascent the precipitation would slowly decrease. Circumstances such as these would naturally be looked upon as affording an explanation of the observed facts in this case. Difficulties in adopting this explanation arise at once, however, when it is noted that the rainfall station at Climax, El. 11,304, directly on the continental divide, shows a precipitation of only 36.11 in., while the adjacent drainage basins to the west show a runoff exceeding 70 in. Pikes Peak, though situated well to the east of the continental divide, shows a rainfall of only 29.55 in. at El. 14,111. These facts lead to the conclusion either that the data must be grossly in error as to either rainfall or runoff, or else there is some factor other than the absolute amount of precipitation as measured in the ordinary way which must be taken into consideration in order to reconcile the figures, even after full allowance is made for all the increase of precipitation with elevation which is apparently possible.

In view of the number, character and duration of the runoff records used there is no reason to doubt the

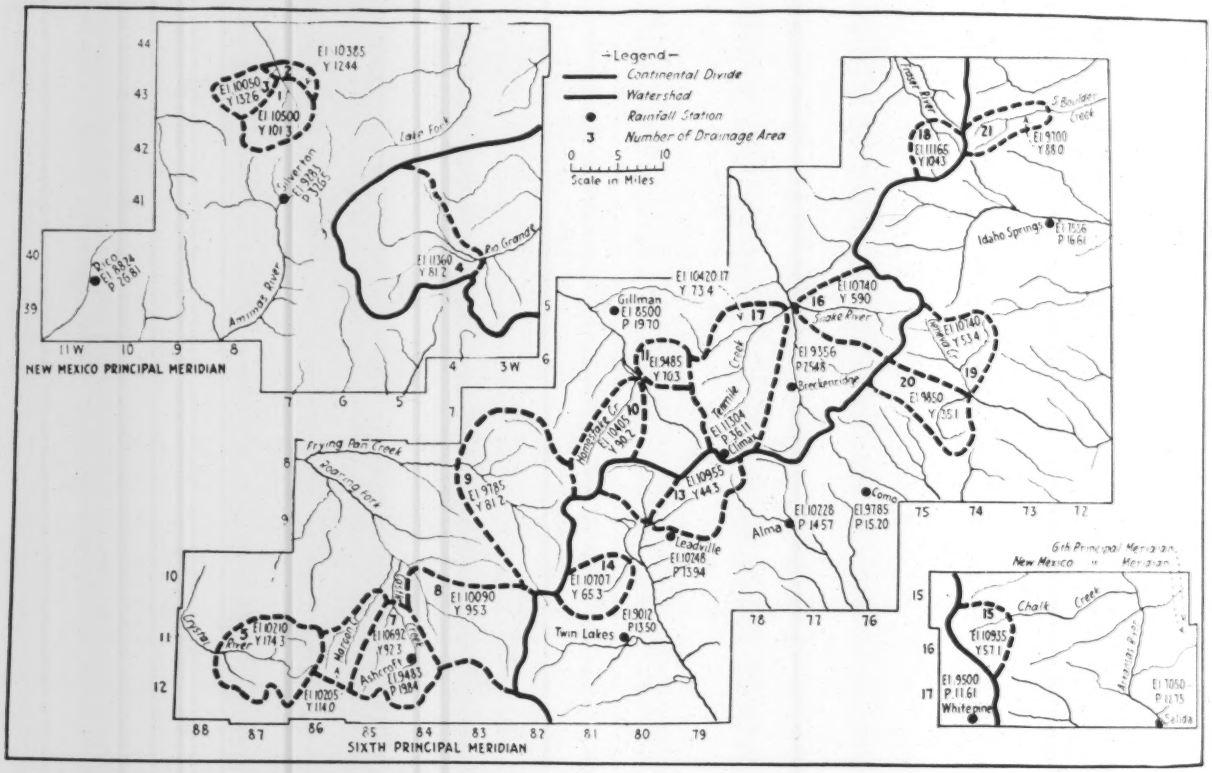

FIG. 1—DRAINAGE BASINS, RAINFALL AND GAGING STATIONS ADJACENT TO CONTINENTAL DIVIDE IN COLORADO
Thirteen basins on west and eight on east slope. See large table for further details.

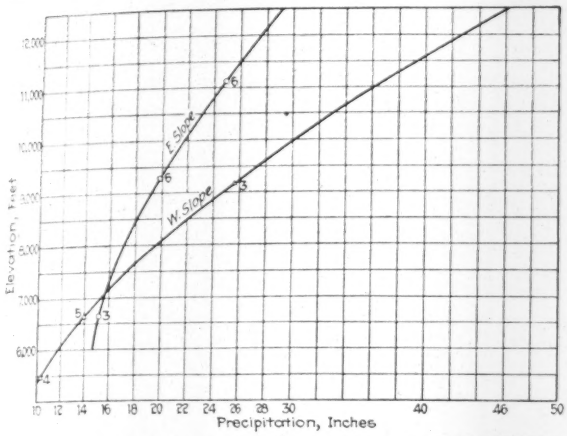

FIG. 2—RELATION OF PRECIPITATION TO ELEVATION, EAST AND WEST SLOPES CONTINENTAL DIVIDE

Figures adjacent to circles indicate number of rainfall stations included in group mean.

essential accuracy, at least of the average. With regard to rainfall, numerous stations have also been averaged and the results for individual stations are generally consistent. Nevertheless in view of the facts that most of the precipitation is in the form of snow, that the region is subject to nearly continuous winds and that measured snowfall when determined by means of the ordinary rain gage can, especially in the presence of wind, is notably deficient, it seems possible that part of the difference may be ascribed to inadequacy of the precipitation records. Quantitatively, however, it is inconceivable that any error from this source is sufficient to account for any more than a fraction of the observed difference between precipitation and runoff. Careful measurements by the writer showed that for the climate of Albany the water equivalent of snow caught in a rain gage can with the funnel removed must be increased 16 per cent to obtain the true precipitation as measured on a suitable snow board (*Monthly Weather Review*, Feb., 1920, pp. 88-9). For a colder climate with finer, drier snow and higher wind this error might be considerably greater, possibly 25 per cent error. Even if the error were 50 per cent in the catch of snowfall it would be utterly inadequate to account for the existing differences. Positive information as to the method of measuring snowfall at these Rocky Mountain stations is not available but presumably the snow measurements are correctly taken at some of the stations at least.

A suggestion commonly made in connection with the hydrology of glaciers is the possible occurrence of direct condensation on the snow surfaces which persist throughout nearly the whole year at these high elevations. Condensation would apparently be nearly the same as at Wagonwheel Gap and it is automatically taken into account in estimating the assumed water losses. Condensation can occur only under conditions which prevail but a small portion of the time even on snow-covered mountain summits in the climate of Colorado. Measurable condensation is seldom observed in evaporation pans, and while some condensation does occur it is certainly a minor factor at best.

Fig. 3 illustrates a condition which may occur in connection with the orographic precipitation of snowfall. Assume that a moisture-bearing wind ascends the slope *ab*, the temperature and moisture distribution in the air current at different levels being such that the condensation locus is along the line *cd*. If the condensation is in the form of snow, then instead of the precipitation occurring on the projected area *ef*, the snow may be carried to a considerable distance by the wind, following paths somewhat as indicated by dotted lines and finally falling on the area *gh*. It will be noted that the wind has a considerable upward component of velocity which aids in keeping the snow in suspension and causing it

YIELD OF HIGH ROCKY MOUNTAIN DRAINAGE BASINS

From data by Follansbee, Water Supply Paper 500, p. 67

No.	Stream	Location in Colorado	Area Square Miles	Per Cent Area Above 9,000 Ft.	Approx. Mean Elevation	Average Yield C. S. M.	Average Yield Inches	Years Included From	Years Included To	Orientation of Basin	East or West of Divide
1	Uncompahgre River	Ouray	44	94	10,500	7.45	101.3	1911	1918	N 45° W	W
2	Uncompahgre River	Below Ouray	76	95	10,385	9.15	124.4	1913	1918	N 45° W	W
3	Canyon Creek	Curay	26	95	10,050	9.75	132.6	1911	1915	N 70° E	W
4	Rio Grande	Thirtymile Bridge	163	100	11,360	5.97	81.2	1914	1918	S 75° E	E
								1911	1915		
5	Crystal River	Marble	77	95	10,210	12.82	174.3	1917		N 20° W	W
6	Maroon Creek	Near Aspen	42	95	10,205	8.38	114.0	1911	1916	N 20° E	W
7	Castle Creek	Near Aspen	62	98	10,692	6.79	92.3	1913	1918	North	W
8	Roaring Fork	Aspen	109	95	10,090	7.01	95.3	1912	1918	N 70° W	W
9	Fryingpan Creek	Thomasville	175	93	9,785	5.97	81.2	1914	1917	N 40° W	W
								1911	1912		
10	Homestake Creek	Redcliff	64	98	10,405	6.63	90.2	1914	1918	N 30° E	W
11	Turkey Creek	Redcliff	27	95	9,485	5.17	70.3	1914	1918	S 75° W	W
12	Tennessee Fork	Near Leadville	45	100	10,460	3.41	46.4	1913	1918	S 45° E	E
13	East Fork of Arkansas River	Near Leadville	52	100	10,955	3.26	44.3	1913	1918	S 45° W	E
								1911	1912		
14	Halfmoon Creek	Near Leadville	26	100	10,707	4.80	65.3	1914		N 45° E	E
15	Chalk Creek	Near St. Elmo	48	99	10,935	4.20	57.1	1914	1918	N 70° E	E
								1911	1912		
16	Snake River	Dillon	92	99	10,740	4.34	59.0	1914	1918	West	W
17	Tenmile Creek	Dillon	113	98	10,420	5.40	73.4	1911	1918	N 30° E	W
18	Fraser River	Near Arrow	28	100	11,165	7.67	104.3	1914	1918	N 40° W	W
19	Geneva Creek	Grant	74	99	10,740	3.93	53.4	1912	1917	S 45° E	E
20	North Fork of South Platte River	Grant	51	92	9,850	2.58	35.1	1912	1917	S 60° E	E
21	South Boulder Creek	Rollinsville	39	94	9,700	6.47	88.0	1911	1917	N 80° E	E

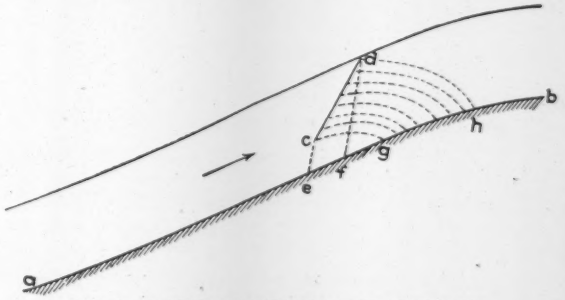

FIG. 3—WIND TRANSPORT OF SNOW UP MOUNTAIN SLOPE

Instead of being projected on *ef* snow may be carried by wind and deposited on *gh*.

to travel forward to a considerable distance in a nearly horizontal direction. This effect does not increase the total precipitation derived from the air current by ascending the barrier. It does, however, increase the altitude at which the zone of maximum precipitation occurs and affords a condition favorable to snow being blown against the slope at a much greater angle to the vertical than generally occurs in the case of rain. Again, while the locus of condensation on a mountain slope is usually at a lower level in winter than in summer, the belt where the condensation actually falls may be raised in this manner so as to be nearly coincident with the belt or zone of maximum precipitation in summer. Again, over the region *efg* precipitation in winter may be comparatively slight because nearly all the orographic precipitation actually reaches the ground in the region *gh*. Indirectly this illustration may have a bearing on the matter of accounting for the requisite amout of precipitation to provide for the observed runoff near the continental divide.

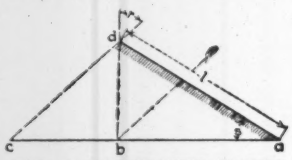

FIG. 4—INCREASED CATCH OF SNOW ON MOUNTAIN SLOPE

Snow falls at much greater angles of inclination than rain, making snow catch in excess of apparent precipitation.

The writer has called attention in a previous paper (Measurement of Rainfall and Snow, Jour. N.E.W.W. Assoc., vol. 33, No. 1, 1919), to the possibility that under such conditions a "roof effect" may occur such that the precipitation caught by a given inclined area is much greater than the apparent precipitation on the horizontal or projected area, even though the precipitation as determined by rain gages within the area is entirely correct. Snow falls at much greater angles of inclinations than rain. Referring to Fig. 4, if precipitation falls at the angle r on the inclined area ad, the precipitation actually caught is to the amount which would be caught on the horizontally projected area ab as ab is to ac, but

$$ab = 1 \cos s;\quad bc = l \sin s \tan r = l \sin s \sin r \div \cos r.$$
$$ac = ab + bc = l \cos r \cos s + l \sin r \sin s = l \cos (r - s)$$
$$\text{and Catch} \div \text{Measured } P = \cos (r - s) \div \cos s.$$

In case the area does not face the wind directly the angle s can be determined by the formula, $\tan s = \tan a \cos b$, where a is the true or maximum slope angle of the area and b is the horizontal angle between the direction of orientation of the area and the direction of the wind. Snow often falls at large angles to the vertical, sometimes 70 to 80 degrees. For a steep area facing the wind the snow precipitation may therefore easily be 1.5 to 2 times the measured precipitation.

The orientation of each of the basins is shown in the large table. Referring to Fig. 1, it will be noted that the greatest runoff occurs for basins facing the west, the runoff invariably decreasing as the orientation turns toward the north. This is in line with the suggestion that the discrepancy may be accounted for by the roof effect just described, although a similar relation would usually hold in the case of increase of precipitation by elevation in the ordinary manner, since the winds would tend to blow along rather than over a divide running diagonally to the wind. There is some evidence of the occurrence of a slope or roof effect of the kind above described in the case of some eastern mountain drainage basins and as this is the only suggestion which occurs to the writer adequate to account for unexplained differences between rainfall and runoff along the continental divide it is offered for what it is worth, in the hope that readers of *Engineering News-Record* will offer suggestions and criticism which will throw further light on this interesting problem.

Steel Still Bright in Old Slag Concrete

IN WRECKING the Higgins Building on the site of the new Union Terminal Station in Cleveland considerable slag concrete has been brought to light. It is interesting to note that the steel reinforcement exposed in the wrecking operations shows no signs of rusting. Investigation of the building reported to *Engineering News-Record* by Wilbur J. Watson, consulting engineer, Cleveland, is as follows:

The building was built in 1907 for the Eldridge & Higgins Co., and until its purchase the early part of this year by the Union Terminals Co. was used as a wholesale grocery warehouse. It was 127x146 ft. in ground dimensions and consisted of eight floors, five above the Ontario St. level and three below. Construction was a combination of reinforced concrete, structural steel, and timber, with exterior bearing walls of paving brick. One floor only was entirely of reinforced concrete; the first floor above the lowest basement level and the columns above this floor and the north part of the third or main floor were also of concrete. The balance of the structure was structural steel and timber.

All material used for reinforced concrete was blast furnace slag with the exception of some of the columns in the second floor in which gravel was used. The reinforcement of the slabs consists of ½-in. plain square bars about 7 in. c. to c. one way, and ⅞-in. square bars transversely. The type of construction was beam and slab throughout. The main beams were reinforced with five 1¼-in. plain square bars, two of them bent up. The concrete slabs are 6 in. thick. The reinforcement for the columns is all structural steel, most of it unpainted, although apparently some of it has been painted with one coat of red lead and oil before being encased.

Wrecking was done by drilling a double line of 2-in. holes about 4 in. on centers around all four sides of the panels and then chiseling out the concrete between the holes and cutting the steel with an oxy-acetylene torch. The concrete was very tough and drilling was consequently difficult. The slag proved to be much more difficult to drill through than gravel concrete. Careful examination of the work failed to show any corrosion whatever at any point in the steel. The concrete itself is in excellent condition and the steel apparently was well placed so that in no case measured did it come closer than ¼ in. from the surface of the slab.

The lowest floor of the building, it appears, was subject to a great deal of moisture owing to leakages through the wall and also to the use of part of this floor for pickling, which must have resulted in considerable acid in the atmosphere. Yet there was no indication of a damaging effect on either steel or concrete.

Maryland Adopts Sewage Cropping Regulations

Since the publication in our issue of Jan. 31, p. 198. of the report to the Maryland Board of Health by Abel Wolman, chief engineer of the board, we have been informed that the regulations recommended to the Maryland State Board of Health on this subject have been adopted by the board.

Gravel Washing Plant for Ballast and Concrete: I.C.R.R.

Hydraulic Dredge in Pit Supplies Screening Plant—Circular Storage Bins—Gravity Yard—Output Capacity and Cost

A FLOATING suction-pump for excavating and delivering gravel is a special feature of an extensive washing and screening plant installed in 1923 by the Illinois Central R.R. at a gravel pit of 160 acres near Forreston, Ill., in order to furnish a supply of clean gravel for track ballast and both sand and gravel for concrete. Two methods of delivering gravel to the plant were considered: (1) Steam shovel excavation and loading into cars for dumping into a hopper; (2) hydraulic excavation and pipe line delivery. The latter method was selected as showing a lower cost and enabling a large supply to be obtained below the ground water line, according to a paper by W. A. Gelbach in the *Journal of the Western Society of Engineers*, from which the following description is compiled:

A barge 26x60 ft. floating in a pit, carries a 12-in. centrifugal pump with 400-hp. motor, a four-drum hoist with a 15-hp. motor, a cutter chain with 15-hp. motor, and a 2-in. centrifugal pump with 10-hp. motor for priming the main pump and maintaining its seal. A suction pipe 45 ft. long has its intake nozzle fitted with a traveling chain screen which carries boulders over 8-in. size out of the way and has manganese steel fingers to loosen the gravel. The hoist has two drums to operate the mooring cables, one for raising and lowering the suction pipe and one for operating a stern spud. A 12-in. delivery pipe line is carried on pontoons to the bank and thence to the plant. For flexibility of the floating portion of this pipe line rubber sleeve connections are employed.

An inclined steel trough having the bottom perforated with ⅜-in. slots receives the discharge from the pipe line and removes the fine sand as well as the bulk of the water. Beyond the trough is a screen plate with 2½-in. holes, this being the maximum size for ballast. Boulders retained on this screen pass to an elevator and are discharged into a bin from which they go to a crusher, the output of which is discharged into the flume under the 2½-in. screen. The crushed stone, together with the water and all material passing through this screen, goes by gravity to a two-compartment bin, from which the water overflows and is returned to the dredge pit. Each compartment of the receiving bin has an excavating elevator which delivers the sand and gravel to the screen house, the floor of which is 62 ft. above track level. Two duplicate sets of screens have each three rotary screens 36-, 54- and 96-in. diameter, with 1¼-, ¾- and ⅜-in. perforations respectively.

Storage Bins—Five concrete cylindrical bins 21 ft. in inside diameter provide for storage of the graded material; three of these are 30 ft. high and the others 40 ft. high. The chutes from the screens are so arranged and equipped with butterfly valves that the three sizes of material may be delivered separately into the first three bins or two or three sizes may be delivered into one bin for mixing. Six sand settling tanks are provided. Two of these are placed to deliver ungraded sand into the middle bin, which is a ballast bin and can receive graded stone of any size as well as the sand. When the sand is to be graded it is delivered by a flow of water to stationary screens over two tanks above the fourth bin (fine sand), the rejections going by chutes to similar tanks over the fifth bin (coarse sand). The screens over the fourth bin have ⅛x¼-in. perforations and require occasional cleaning by hand.

Much preliminary washing is done in pumping, but when there is a large proportion of fine material, additional water is delivered at the screens and settling tank by a 6-in. centrifugal pump with 100-hp. motor placed in a well 10 ft. square and 33 ft. deep, the pump being about 5 ft. above the water.

Gravity Yard—Gravity switching is provided for the car yard. Empty cars in a yard of sixty cars capacity are dropped down a grade of 1 per cent to the plant, where they are checked by a grade of 0.5 per cent for loading and are then moved by a car puller to a second 1 per cent grade which carries them into a yard of seventy cars capacity, from which the trains are taken by locomotives. Electric power is used throughout, current being taken from an adjacent transmission line and delivered to transformers. The cable to the dredge is supported on the pontoons. Flood lights are provided for night working.

With a force of thirteen men the rated output capacity is fifty carloads per 10-hour day, but the capacity varies with the character of material encountered. This force comprises a superintendent, assistant superintendent, 1 barge pump man, 1 barge helper, 1 tender for suction pipe screen, 1 tender for crusher and screening plant, 1 man at car puller, 2 men loading cars and 4 men handling the empty and loaded cars. The production cost was naturally high when the plant was first put in service and is given as probably 60 to 75c. per cubic yard, "but when the plant gets into full operation the cost should not run above 30c. per cubic yard."

This work was planned and carried out under the direction of F. L. Thompson, chief engineer, Illinois Central R.R., and F. R. Judd, engineer of buildings. The W. J. Zittrell Co., Webster City, Ia., had the contract and sublet the machinery equipment to W. H. K. Bennett, Chicago. W. A. Gelbach, supervising engineer for the W. J. Zittrell Co., was in direct charge of construction.

A School of Surveying

Under the management of the American Geographical Society, New York, a school of surveying has been organized to train men in the theory and practice of topographical surveying and field astronomy, so that they may be qualified for exploration and also fitted for government or industrial work. Individual attention will be given to each student; he will put the theoretical knowledge he acquires to practical test in the field, and he will be given facilities to handle surveying instruments. The society will give a diploma to those students who complete the whole course, which should be accomplished in from one to two years. A shorter course can be arranged, in which the student will learn only what is most essential in connection with his work. Students are assumed to have had mathematical training, an understanding of plane and spherical trigonometry and thorough familiarity with logarithmic calculation are essential. The tuition for the full course is $300 and for a short course at the rate of $30 a month. Dr. Alexander Hamilton Rice initiated the plan and is director of the school.

Transmission Line Work Aided by Aerial Survey

Advantages and Limitations of Air Mapping Accurately Evaluated in Two High-Tension Lines in Pennsylvania—Aerial Survey Cost Less Than $50 Per Mile

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AERIAL photography was recently employed to facilitate the rapid completion of two high-tension transmission lines, 25 and 30 miles in length, respectively, in the southeastern corner of Pennsylvania. The country here is traversed by frequent highways and several railroads, and is of a slightly rolling nature, with occasional well-rounded hills of moderate relief. There are some wooded strips but in the main the land is highly cultivated for agriculture. The lines are a part of a transmission system which embraces approximately 100 miles of easily accessible transmission routes. The line construction consists of copper cables supported by double circuit steel towers 50 and 60 ft. high to the lowest crossarm and insulated for 110,000 v. right-of-way work was in progress before the aerial photography was started, and was carried out in connection with the aerial work, so that assistance therefrom was readily appreciated. A contract was made with an aerial camera corporation with headquarters in New York City; and it is thought that this is decidedly the better method of handling a job of this character.

Photography—The photography for the lines under discussion consisted of contact prints and complete strip maps, with special stereoscopic views taken of some of the towns and of some properties to assist in obtaining right-of-way privileges. At the time of starting flights the approximate location of some portions of the lines was undecided, although terminal points were known. For this reason four overlapping parallel courses were flown at some points, giving a strip mosaic covering about six miles in width. At other points two parallel courses were flown. The parallel courses overlapped each other but not to the extent that adjacent pictures in a course did. The average flying elevation was 12,000 ft. and the maps were finished on the scale of 1,000 ft. to the inch. A single photograph showed a ground area of about one and one-half by two miles. There were in the neighborhood of 500 single photographs taken for the line strips. It was desired that the photographs, i.e., maps, show all water courses, islands, railroads, highways, roads, lanes, fences, field lines, cultivated, rocky, wooded, brush or gullied lands, and all buildings, sheds and structures, particularly schools, churches and cemeteries.

A standard biplane driven by a 150-hp. motor and capable in calm air of a 6-hour flight at 60 miles an hour was employed in the flying. It was equipped with an observer's cockpit in the floor of which an opening was provided for sighting the camera. The camera made a picture about 7 by 9½ in. in size and used a roll film containing about 100 exposures. A high-speed shutter placed between the lens and so designed to expose the film completely before the plane could change its position enough to cause any shifting of the focal axis at the ground level was the most essential part of the camera. A shutter of the ordinary construction would cause distortion of the picture if the camera or airplane were tilted while the film was being exposed. The camera was suspended in a gimbal bearing so that it could be leveled by hand to keep the focal plane of the camera parallel with the ground surface.

At the end of each day's flight the films were at once mailed to New York for development and printing, and contact prints were returned to the power company within two to three days. The variation of overall scale of these prints was caused by the changing elevations at which they were photographed; the variation was immaterial, however, for the use to which they were at once put. To illustrate the variation between successive prints the following list is shown for prints numbered 304 to 317 inclusive. Scales in feet per inch are 1099, 1097, 1097, 1093, 1093, 1100, 1100, 1110, 1100, 1100, 1090, 1090; these show a deviation between maximum and minimum of about 1.8 per cent. Air conditions and airplane control account for the variation of altitude between successive pictures, while altitude meter errors probably cause the change of altitude in different parts of the course. These latter changes were generally larger than the change between successive pictures. Another source of scale variation in adjacent pictures was the displacement of objects at different elevations on the earth's surface. As an extreme example of this, a high spot photographed near the edge of a vertical picture appears farther away from the center of the picture than it really is. In the next picture, when the airplane and camera are directly over the high spot, the surrounding low areas then seem to be closer to the photographic center than they actually are.

There is a choice between glossy and dull prints and this is decided purely on the convenience in use. Where it is the intention to add pencil or ink markings to the prints, the dull finish is better; the glossy print is perhaps more permanent. The position of each print was at once plotted to the proper scale on standard U. S. Geological Survey quadrangle maps by reference to highways, water courses, and other clearly-defined marks. Information of missed areas gained in this way enabled the aviator to secure the necessary photographs on subsequent flights.

Harmonizing Photography and Surveys—This brings us down to the point where use of the aerial photographic data actually began. The contact prints were studied in connection with the quadrangle maps and a line location laid out on the prints according to the most desirable possibilities of avoiding obstructions, high-priced land, and construction difficulties; also with the idea of accessibility during construction and for future maintenance. The prints were then put in the hands of the men securing right-of-way options. With their help the right-of-way agents located themselves at once on the proposed route and after a little inquiry determined the names of the property owners, which were given to the men making searches for descriptions of properties. As the agents had started in the field with

the government quadrangle and postal maps as their only guides, it was found that some unnecessary options had been obtained and other needed ones had not been thought necessary by the field men. The photographic prints with the line location marked on them immediately remedied this condition. As fast as descriptions were obtained from the county records the property outlines and owners' names were inked on the prints. When surveying parties were sent out to establish the final alignment and to determine the profile of the route they carried into the field the mosaics with the line route and property lines marked on them, and used them throughout the survey as described later.

There are several steps in transmission line work, each of which required special information of the country and properties traversed by the transmission line. The first undertaking is to select a route. Unless there are some known intervening obstructions of magnitude, the best procedure would be to project the line directly between the terminals. We shall suppose the first point is decided upon. The second step consists in locating this proposed line on the ground and determining if there are any minor obstacles, or if the line could be laid out to better economic advantage. The most direct route may not be the cheapest in the end, and may be entirely impossible because of various topographic features. The only available maps are the U. S. Geological Survey quadrangle maps and postal maps, but they do not show sufficient detail to enable the line location to be checked.

TYPICAL AERIAL MAP SHOWING METHOD OF INDICATING PROPERTY OWNERSHIP
Location of transmission line and towers indicated.

We will consider first the methods usually applied heretofore and then take up the aerial method of line location. The primary purpose at this point is to obtain a somewhat clear perception of the topography of the country. The ordinary method in the past has been a preliminary survey, or line location, by a field survey party. This is somewhat of a trial and error procedure, and may result in a considerable expenditure of time. As usually carried out in the field the line is located, after a study of the U. S. G. S. maps, to the best advantage for transmission line purposes. The field work requires an examination of the surrounding land and readjustments when physical difficulties are encountered. The object of the survey will likely be divulged and opposition will be met at times. In a closely-settled country such as the territory in southeastern Pennsylvania it is doubtful whether any surveying at all could be done without considerable advertisement. The survey will show the alignment and profile of the route, topographical data for the region adjacent to the route, railroads, roads, lanes, property division lines, and telephone, telegraph, and power lines crossed by the route of the transmission line. Property lines will not be extended to define the complete property and many may be overlooked. The survey data will also record the property owners' names. It will be noted that the results of the survey apply only to the territory touching the proposed route, that they have been obtained by direct contact with property owners, and that although considerable time and effort have been put in the survey, the survey may have to be repeated in case the route of the line has to be changed later.

Contrast the above description of the usual preliminary survey with the method of obtaining the same result by an aerial survey. If weather conditions are favorable the aviator and photographer may ascend miles away from the vicinity and within three or four hours have sailed twice along the 55-mile route, taken pictures every few seconds, descended and stored their airplane in its shelter. Probably no one at all saw them as they flew along, over two miles above, and if they were noticed, any comment was quickly forgotten. The films are developed and in two or three days, contact prints are at hand, and in two or three weeks a mosaic of the entire region. We will now examine them and see that each cultivated field and wooded lot are clearly discernible, things that are not shown on the government map. We find roads and lanes meandering around in a different fashion than those on the government maps, and where the quadrangle map shows a small dot we count several scattered buildings, and even find buildings where none is indicated on the government map. We look closer and count the trees in the orchards, and the corn shocks in the fields. We compare the contour lines on the government map with our aerial prints and the hilltops and ridges seem to stand out. We even see where the rains have washed gullies in the hillsides. So we pick out the hilltops and ridges that skirt the wooded areas and draw in our line route so that it misses farm buildings and orchards and schoolhouses, and decide we have a tentative location for the line.

Just to be sure of this we take the maps with us on a day's ride through the country. Leaving town on the road that starts out in the direction of the proposed line, we see by the map that we should swing off at the second crossroad where there is a house and barn and a tree or two beside the road. We pass these and notice on the map that about 1,000 ft. farther on we

should enter a wood and turn sharply to the right where the road branches. In this way we travel along the route and see that the line we have sketched on the mosaic will do very well for the transmission line. If the roads are in good condition we will have checked up the line location in a day. We made note of all communication and power lines as we passed them, but we still do not know who owns the land along the route. So we will call on a few reliable acquaintances and show them the aerial maps, and in another hour we have traveled along the proposed route on the map noting the names of most of the landowners.

Let us now compare the information we have obtained in two weeks with that brought in by the preliminary survey party. The only things we lack are detailed alignment and profile data, but such information is not essential at just this point because we do not yet know if we can procure readily a right-of-way easement for the proposed route. However, our information will allow us to reroute the line in a few minutes if necessary later. We decide the aerial method has effected a saving of time and money in enabling a preliminary location of the line but we will not charge the cost of the survey entirely to the preliminary work. As will be seen in later steps, its advantages will be more fully realized.

Securing Property Descriptions—The third step in the line project is to obtain a complete description of the properties over which the route passes. This is necessary for two reasons: first, to facilitate the discussions when negotiating for right-of-way privileges; and, second, to insure that a right-of-way is obtained on every parcel of property over which the line passes, whether towers are placed on it or not. We might interview the owners and obtain most of the property outlines from them, but this would be a slow, incomplete and irritating job. The other course would be to search the property records kept at the county courthouses. The magnitude of this undertaking will vary with the average size of the properties, the age of the property records, and with the accuracy with which the land has been surveyed and parceled into separate lots. This part of Pennsylvania was settled in early times and by repeated transactions has been divided into plots ranging in size from an acre to a hundred or more acres. The third step, then, consists of making a continuous property map of the line route from the information to be found in these records. Previous experience had shown the unsatisfactory state of the records, and the time and expense required to make a complete property map, so it was thought the aerial survey map might facilitate this phase of the transmission line work.

The records are first entered by property owners' names and by township, and each lot description plotted separately. Where an owner possesses separate lots the one crossed by the route must be selected from the available data. This may be easy or not, and may depend on descriptions of neighboring properties. The aerial map shows at a glance the lot location. After several lots which are thought to be adjacent and on the line route are plotted an attempt is made to join them together, somewhat on the puzzle board idea. If there are missing descriptions or inaccuracies in the records it may be impossible to join them together, and a complete search of all the records from the beginning may be needed to locate the fault in the lines. With the aerial map the procedure is just the reverse. The map of the actual ground layout is before the plotter and he uses the map to confirm the record descriptions. When the descriptions are incomplete or erroneous, or a starting point is given that is not definitely located one endeavoring to complete the map in the ordinary manner may spend a day on a few properties and accomplish nothing. Some records were as indefinite as "a certain five acres located in ——— township and bordering on the land ——— of ———." Without the aerial map the only recourse would have been a field survey of this and adjoining properties.

Some property had also been transferred by will without any description being put on record. To clear up such plots it would have been necessary to interview the owners; for the present purpose however the aerial map enabled these gaps in the route to be closed by plotting the surrounding properties.

Obtaining Rights-of-Way—The fourth step in the transmission line project is to obtain easements, pole or tower rights, tree trimming and cutting privileges, and ingress and egress rights during construction and for patrolling. It is of course advisable as far as possible to select agents acquainted with the country and inhabitants. Even with their knowledge of the country and the information it is possible to supply them from the preliminary survey the agents have always been at a disadvantage when talking with the landowners. A dilatory attitude is taken by the landowner when he is not inclined to accept the standard offer which the agent makes for right-of-way privileges. He thinks that by holding out he will be able to get better terms and he shapes his arguments to that end. The aerial maps are a convenience to the agent at this juncture and save him time and expense. The owner desires to know where the line crosses his land and when informed he at once offers objections and commences to figure damages. He may suggest considerable change in the location of the line, as the reasons underlying its choice are not always apparent to him. With the aerial map spread out before them the agent and owner discuss these points without tramping over the fields to settle disputed questions as to lines, proximities, and orchard damage. The relation of the owner's land to that of his neighbors can be quickly depicted, and the line location justified. In fact, the negotiations do not need to be conducted in the vicinity of the property as the aerial maps give a better overall comprehension of the land than can be obtained on the ground level with a limited horizon. When the landowner happened to become obdurate to the agent's offer, and it was increasingly difficult to arrive at a common topic for conversation, the agents found the stereoscopic views of interest to the owner and his family, and by donating a stereopticon and several views of the vicinity an opportunity was obtained for further parleys and negotiation. At no time in the right-of-way work did any one attach the idea of an ethical violation to the aerial survey. Instead, there seemed to be a distinctly favorable impression resulting from the use of the aerial maps.

Terms of Adjustment—The fifth step in the project is necessary when some of the landowners fail to accept the terms offered for the privileges desired on their land. Two courses are possible, either to use the right of condemnation, or to make a detour around the obstructing properties. The photographic maps afford

a quick means for the latter without any field work. Because of the irregularity of the property boundary lines, options may have been secured already on the neighboring properties and nothing else is therefore necessary except to relocate the line according to the physical features of the land. If other options are needed all necessary information is at hand and they may be secured without the advertisement a field survey would give. A case of relocation occurred where the line was laid out to avoid some heavy timber at one point and more remotely a group of farm buildings. The line passed over some fields in between but the owner insisted on the purchase of the entire fields in lieu of tower rights. The map showed a narrow neck of cleared area in the owner's land less than a normal span in width. As an option had been obtained for tower rights on the adjacent property it was decided to swing across the neck and with a slight angle miss the timber, farm houses, and obstructing property. Such a possibility could have been found by a ground survey but not with the facility the photographic maps gave.

Land Title Investigation—The sixth step in the work is necessary to determine if there are any liens or encumbrances against the property traversed by the line route, and to insure that the deed received for the tower and line privileges is good. Where the property is mortgaged, a release must be secured before a clear title can be taken. The work required and the difficulties met are quite similar to the description of the property record searches above. In this case, however, the search has to be carried back to the original grant and is therefore more extensive.

The search sometimes brings out a small property for which a right-of-way deed should be obtained. No effort should be spared to have the title search correct and complete, and considerable expense may be incurred before it is finished. The photographic map was used to advantage during the search, as the searcher started with the present property outlines sketched on the map and therefore had no difficulty in orienting the properties.

Final Survey Made—After a satisfactory right-of-way had been obtained the final survey for alignment and profile mapping was started. Essentially this consisted of staking the line out in the field as it had been laid down on the photographic maps, and of determining levels for the profile so that tower locations and heights could be determined. The photographic maps found a ready application in locating the surveyors in the field, and were of much assistance in recording the notes about buildings, property lines, and other topographic data. The maps were scaled to obtain approximate distances but did not save any chaining. An instance occurred wherein the line entered a stretch of rough timber land a mile and a quarter wide. There was an angle in the line at the edge of the timber and it was impossible to establish a line by sight across the woods. The photographic map showed a clearing jutting into the woods and the projected line just touching the tip of the clearing. This information led to an offset which enabled computing the angle at the entrance of the timber. The final surveying followed closely after the right-of-way men, and constant reference was made to the maps to keep the surveyors informed of the status of the right-of-way.

As just indicated, the separation of the work into the several steps was not as definite as has been necessary for description. The line as a whole was in several stages of development at once, because any one step did not have to be completed entirely before commencing the succeeding. The photographic maps proved to be the co-ordinating instrument, and they received the hearty approval of every one connected with the work. Similar use was made of them during the active construction of the line in order to show delivery routes to unfamiliar truckmen in distributing camp supplies, tower and foundation material, to locate entrance points on properties, and to expedite all references to field locations.

Technical details of the camera, and the developing and printing processes, was work handled entirely by the contracting photographer. It was necessary before combining the contact prints into the mosaic, to reduce or enlarge them to the same scale. The scale of the prints was first computed with the aid of the government maps; the reproducing camera was then adjusted to give a second negative to the proper scale. Several points that could be identified both on the government maps and the prints were next laid down on the scale of the prints, using the government maps to obtain the exact horizontal distances. The prints were then assembled around these control points, using those that showed the least distortion and displacement. A slight amount of displacement could be remedied by shrinking or stretching the print to gain coincidence at the edges where the prints joined. After the prints had been assembled and checked for accuracy against the government maps, they were re-photographed and the mosaic print mounted on linen. The mosaics were prepared in sizes of 20 x 24 in. and in rolls showing 25 and 30 miles of the line route.

It is thought that, nothwithstanding the delay caused by bad climatic conditions, the cost of the aerial maps has been greatly outweighed by the advantages. It would be difficult to express this in any definite figure as some of these benefits, such as the saving of time and the psychological advantage of quick right-of-way work, are not susceptible of accurate evaluation. Of those items that can be more nearly approximated in figures the saving in ground survey expense is the most important. It has been roughly estimated that about half of the cost of ground surveys such as would have been incurred without the aid of aerial photography, has been saved. The cost of the aerial survey, including contact prints and mosaics, was less than $50 per mile.

It is recognized that the application of new methods and apparatus in engineering work is justified only on the economic ground of a reduction in overall costs. The saving may be realized directly in material expenses or indirectly by the saving of time. There were no suitable precedents which could be studied and compared before undertaking the aerial survey.

Acknowledgment must be made of the trained personnel and experience of the photographic corporation for the satisfactory completion of the survey. The saving of time and expense in obtaining information about the topography of the country, the saving of time in property record searches, the assistance derived from the photographic maps in right-of-way negotiations, a feature not readily susceptible of accurate evaluation, and the economy of time in the alignment and contour surveys, are the basis for a judgment of the engineering prudence in employing this novel method.

Plan for Industrial Community of Alcoa, Tennessee

Aluminum and Lumber Companies Occupy Central Area, with Low Lands for Park Areas Forming Five Breaks, Seven Main Thoroughfares and Whole Street System Adjusted to Contours

By Robert F. Ewald
Aluminum Company of America, Pittsburgh, Pa.

During late years the establishment of large industries in areas hitherto practically undeveloped has offered some unusual opportunities for the preparation of well defined plans to govern the growth of the communities that naturally build up about these industries. These opportunities are unusual in that the plans are not hampered by existing construction and are less subject to the vicissitudes of public opinion than those plans that involve large amounts of reconstruction work. Older communities, for which adequate plans were never made, are now paying heavily for widening and straightening streets, cutting diagonal thoroughfares to relieve the time-, power- and temper-consuming methods of travel imposed by the rectangular type of development so common in this country; in extraordinarily expensive grading and sewer operations incident to the failure to consider topography in laying out streets, in high water rates due to uneconomical lines of distribution forced by indirect alignment of streets, in high insurance rates due to failure to correlate park and street developments in such manner as to provide continuous firebreaks; and in the enormous indirect losses involved in failure to establish zones defining type of occupation, which failure has all too frequently permitted the invasion of high-value districts by low-grade types of occupation.

SPRINGBROOK OR NORTH CENTRAL PORTION OF ALCOA, AN INDUSTRIAL TOWN IN TENNESSEE
The "Smokies" or Great Smoky Mountains in the background beyond the range of hills, add a hazy charm to the view. The crest could be indicated here only by retouching the photograph.

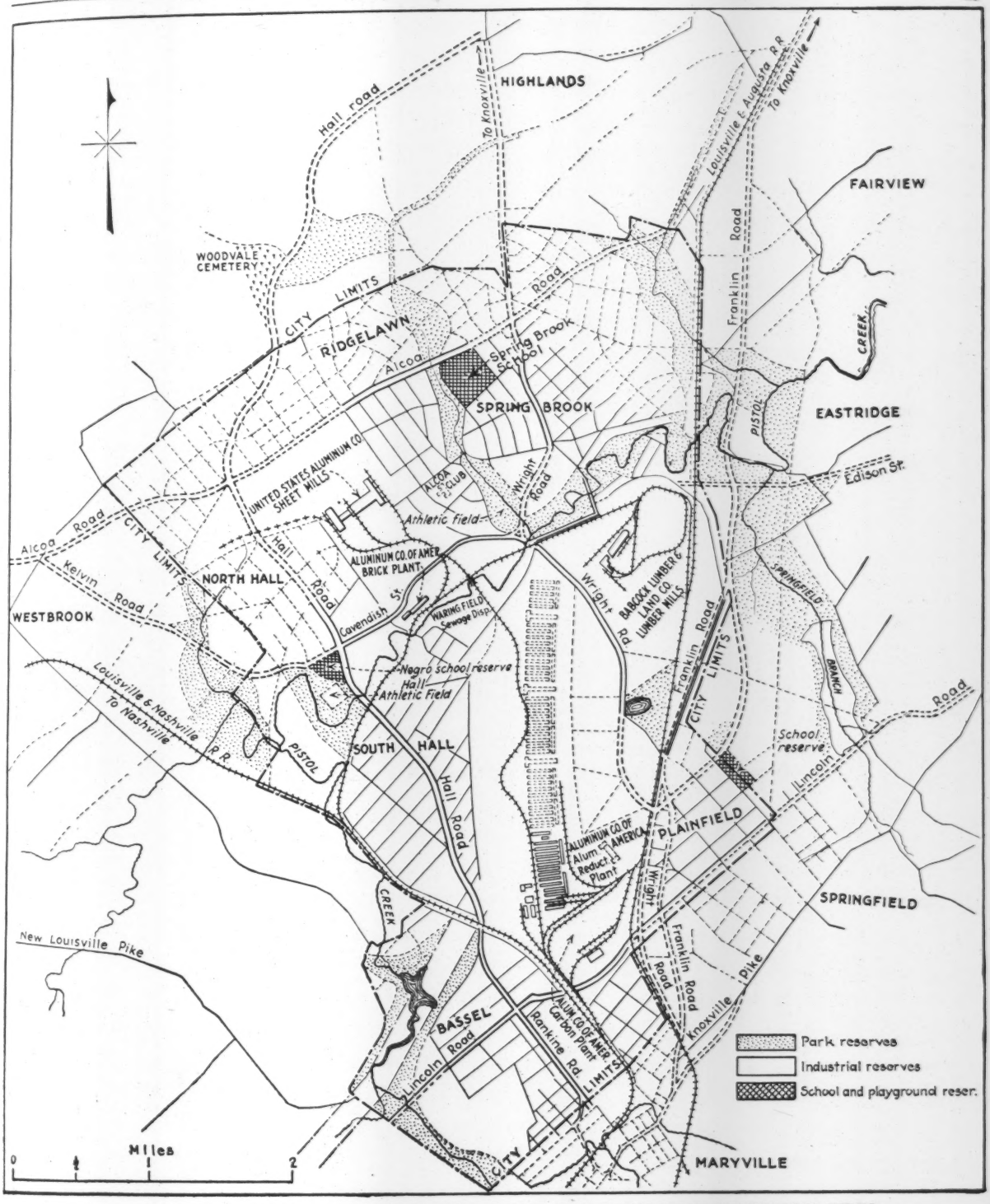
A Clean Slate—An opportunity to avoid many of the mistakes recited was seized at Alcoa, a new industrial community that has developed in the heart of the rich farm lands of East Tennessee during the past five years. Alcoa is fourteen miles south of Knoxville, on the Knoxville & Augusta Ry. (a part of the Southern System) and on a short branch from the main line of the Louisville & Nashville R.R. between Cincinnati and Atlanta. The established industries include a plant for reduction of aluminum from the oxide; a separate plant for the manufacture of the carbons required in the process of aluminum reduction; a plant for rolling plate and sheet from the metal; and one of the largest saw mills in the South, drawing upon the great timber resources of the Smoky Mountains, fifteen miles to the southeast. Large deposits of medium grade iron ores in the same mountains and the possibility of developing more than a half-million horsepower on Hiwassee, Little Tennessee, and other rivers in the near vicinity, in addition to the extensive developments already made, promise marked growth in the future and all indications are that the present city of 4,000 will ultimately have a population many times this figure. The Aluminum Company of America and its subsidiaries and the Babcock Lumber & Land Co. are the principal land owners in Alcoa. The city government, of the commission type, was organized in 1918.

The land surface is generally rolling and, in limited localities, rugged enough to develop a high degree of natural beauty. This feature, coupled with the magnificent views of the Smoky Mountains obtainable from all sections of the town, stimulates a desire to make the best of every opportunity to develop the natural attractiveness to the highest possible degree compatible with utilitarian purposes.

Making the Plan—The methods used in making the plan may be of considerable interest. In general it has been the intention to follow the best modern practice but in some cases deviations from accepted practice have been introduced.

There is available a topographic map of the entire area on a scale of 500 ft. to the inch with 5-ft. contour intervals. This was used as the base map but in the final analysis an intimate personal acquaintance with almost every acre of the territory involved influenced the plans to a marked extent.

The completed plan consists of four maps, together with explanatory text. The first map of the series



GENERAL PLAN OF ALCOA, AN ALUMINUM AND LUMBER TOWN NEAR KNOXVILLE, TENN.

The industrial plants occupy a central north-and-south strip, surrounded by residence sections. Liberal park areas serve also as fire breaks. The seven major streets follow contours and the street network is adjusted conformably.

shows only the salient features of the plan and forms the framework to which the details were fitted. The second map shows old, present and proposed streets. The other two maps show existing and proposed sewerage and existing and proposed water distribution systems. Only the second map is reproduced here. The irregularity of the plan is so marked as to appear studied and gives semblance to many of the "new art" plans evolved in Europe during late years and in some cases used in this country. It is true that the irregularity is studied but it is not an expression of the spirit that prompts the imposition of weirdly curved

street systems where the topography does not require such treatment; on the contrary, it is primarily a result of purely economic consideration of the situation and incidentally the utilization of opportunities for enhancing attractiveness.

As Alcoa will always be an industrial city the first consideration has been the reservation of large continuous areas of land as nearly level as possible and capable of being tied together by belt railroads for industrial sites. The plan recognizes the fact that these areas will become the center and not the outlying districts of the future city. Through the heart of the site is a small stream, Pistol Creek, with a drainage area of about 30 sq. miles, fed by numerous small tributaries. The main stream and some of the tributaries have a very flat gradient and are bordered by large areas of low flat ground that cannot be readily sewered without pumping. These lands are to be utilized for a system of long narrow parks, which, by proper interconnection, divide the entire area of the plan into a number of districts completely separated by open spaces or firebreaks and provide a park area within a half-mile of any home. After the industrial and park areas had been laid out it was found that a number of districts with natural boundaries had been formed and that three great north and south highways, Hall Road, Wright Road and Franklin Road, and four east and west thoroughfares, Alcoa Road, Cavendish St., Edison St. and Lincoln Road, would be required to properly tie these districts together and form the "major arterial thoroughfares." The minor arterial thoroughfares constitute diagonal short-cuts from district to district or from one industrial area to another. The matter of social segregation is one of great importance and the reservation of the North Hall and South Hall districts is for the colored population.

The plan was worked out in detail for an area of 5,000 acres and sketched in for an additional 2,500 acres. With a population of eight persons to the acre, provision is made for a population of 40,000 to 60,000. This population may never be attained but as it is not possible to define the direction of growth and as it is necessary that the probability of growth in all directions be considered it is at once apparent that the plan must in any event be more extensive than the area that will be actually occupied. "Paper cities" like these are the butt of many jokes but the requirement of providing for growth in all directions makes the super-extensive plan a real necessity.

The Street System—The "cartwheel" type of plan has not been exactly followed at Alcoa for the reason that topographic considerations have located the great industrial plants in the heart of the plan rather than around the outskirts. Even omitting topographic considerations this is entirely logical, for, since the great industrial plants will form the office and workshop of four-fifths of the city's population, the central location of the industrial district is really natural. The desirability of maintaining great areas intact and unbroken by public thoroughfares for large industrial plants to some extent breaks up the wheel form of plan and the main thoroughfares form an irregular net tying together certain districts rather than tending to concentrate traffic in one locality.

Economy in construction and use requires the avoidance of steep gradients, costly cuts and fills and tortuous lines of drainage. These factors, to a marked extent, have affected the location of the main arteries so as to fit them economically to the topographic features. This will explain the more or less curved alignment of many of the principal streets. The main thoroughfares have all been projected well into the outlying districts to definite connections. In those areas well outside the present city limits, the layout of the sub-divisions has been left to the property owners, but within the area surrounding the present nucleus the location of minor streets has been worked out in considerable detail as it was found that the arbitrary location of main thoroughfares, when not governed by topographic considerations, frequently resulted in sub-divisions difficult to plat without an excessive number of badly shaped or poorly sized lots, or in districts encumbered with unnecessarily expensive sewerage and water-supply layouts. Considerable care was required in locating the major thoroughfares to avoid unnecessary intersections which would produce undesirable building areas and lead in the future to undesirable traffic concentration.

Residential Streets—The residential streets are almost without exception at right angles to the main lines of travel and are so located that houses on both sides of the street share equally in the beautiful views. By running these streets at right angles to the contours lots on opposite sides are kept at nearly the same elevation. These considerations fit in very nicely with those of using the contour streets with easy grades for principal thoroughfares. The residential streets, therefore, are much steeper but this disadvantage is offset by their more limited use for traffic and the reduction of lot grading operations to a minimum.

Street Widths and Sections—Owing to the peculiarities of the plan the selection of proper width for the streets is a matter of unusual importance. The absence of parallel streets as a rule forbids traffic diversion to any great extent, so errors resulting from making the principal thoroughfares too narrow are of serious future importance. On the other hand it was desired to avoid needless waste of land, needless expense in paving and the "lonesome" appearance incident to the use of excessively wide streets. To facilitate the design of street widths a complete classification was made of all streets embraced in the plan, the classification being based on type of section and the type of section on the number of lines of traffic to be provided for, making the width commensurate to the traffic that ultimately will be borne.

In developing the designs for street sections on all arterial thoroughfares, pavement widths have been specified which will permit a definite number of traffic and parking lines and can be widened to accommodate a definite increase in number of traffic lines. Sidewalks on all streets are placed near the curbs and trees are planted next to the property lines to afford the maximum possible unpaved area about the roots of the trees and to avoid injury by collision from automobiles.

Local Transportation—For many years to come the motor bus will serve as the principal means of passenger transportation. Eventually, when the population becomes great enough, electric traction will come into use and the street system is designed to fully accommodate such a traction system. Hall Road and Wright Road, notably the latter, probably will be called upon to carry a large amount of high-speed traffic between

Maryville and the Springbrook District in Alcoa and these thoroughfares provide for a separate right-of-way for car lines in the center of the street.

With the exception of certain minor crossings now in use, advantage is taken of topographic features to avoid grade crossings on railroads, thus introducing another factor into the problem of locating arterial thoroughfares. As many as possible of the crossings were so located that grade crossings can be used until such time as the construction of viaducts or subways can be economically justified.

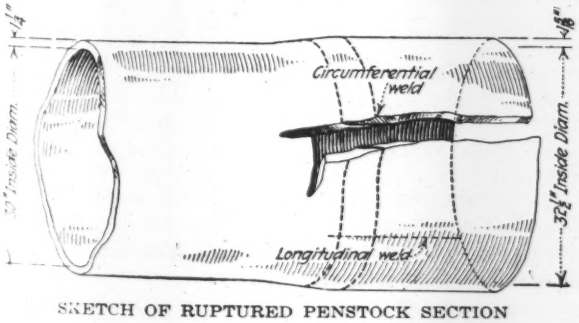
Zoning—The matter of zoning has already been touched upon in discussing the location of industrial and park areas and these features will naturally guide the character of occupation of contiguous territory in the future. Some additional restrictive legislation will be required to govern the establishment of light industries, the permissible type of dwellings and proportion of lot areas that can be built upon but such action is preferably to be taken from time to time, as needed, in order to avoid encumbering the general plan with unessential details that in all likelihood would have to be materially modified in years to come.

High-Head Penstock Failure Found Due to Bad Steel

Section of Thirty-Inch Pipe for 1909-Ft. Head Ruptures Through Laminated End of Plate—Welds Not Affected

ON DEC. 26 last, while the nearly completed high-head Eldorado power plant of the Western States Gas & Electric Co., near Placerville, Calif., was being made ready for trial operation, a section of the penstock burst while being filled. No material damage was done, and the operation of the plant was only delayed about three weeks, as by rush work the builder of the penstock succeeded with the help of a fast cross-continent express shipment in getting a new section in place in the line within two weeks from the date of advices to proceed. The circumstances and probable cause of the rupture of the penstock were studied by both the designer and builder of the plant, the Byllesby Corporation, of Chicago, and the makers of the penstock, the M. W. Kellogg Co., of Jersey City. The facts determined by these investigations are given by the makers, speaking for both parties, in the following account.

For the Eldorado plant, which is one of the highest-head water-power plants yet built in America, forge-welded pipe assembled with riveted bumped ring joints was chosen for the penstock construction. The static head at the bottom of the penstock is 1909 ft. The penstock is a single line of welded pipe, ranging from 54 in. in diameter at the top to 42 in. in diameter about 300 ft. above the power station, where it divides by means of a special Y-piece into two 30-in. lines, each one supplying a single overhung impulse wheel of 14,000 hp. The shell thickness ranges from $\frac{3}{8}$ in. at the top of the line to $1\frac{7}{16}$ in. at the bottom. The section which ruptured is some distance above the bottom of the pipe, where the static head is normally 1885 ft. This is at an expansion joint, and the section was made up by welding a short length of 32½-in. pipe to a length of 30-in. pipe, the enlarged upstream end receiving the end of the next length above in a sliding joint.



SKETCH OF RUPTURED PENSTOCK SECTION

At the time of the break the line was being filled, and filling had progressed nearly to the top. The pressure which existed in the pipe at the time of the break is involved in some doubt; the known facts as to the water level in the pipe would make the static pressure 790 lb. per square inch, though the gage at the power station showed only 760 lb. It is believed that the gage was not in condition to give an accurate indication at the time.

The pipe ruptured through its larger end, tearing apart longitudinally on a length of about 6 ft. and ending in a short circumferential tear which allowed one side of the break to open out a foot or so under the pressure. The sketch herewith indicates the shape of the break and its relation to the welds of the pipe. It will be seen that the break was on the opposite side from the longitudinal weld and passed through the circumferential weld just as through normal metal of the pipe.

Examination of the fracture showed a normal weld without apparent defect, and normal, good metal except in the neighborhood of the sharp corner at the intersection of the longitudinal and circumferential tears. At the circumferential weld the metal was thinned slightly in forging.

At the corner of the two tears the plate is markedly laminated. There are a number of separate layers of steel visible, separated by dark streaks. It is believed that the fracture started at this point, directly downstream of the circumferential weld, the break then extending upwards through the weld and through the 5-ft. length of the 32½-in. pipe to the upper end of the section. The stresses in the material under the conditions of the break were very moderate. With a pressure of 790 lb. per square inch the tension in the 32½-in. pipe was about 9,700 lb. per square inch and in the 30-in. pipe about 9.400 lb. per square inch. At the point of the circumferential weld where the metal was slightly thinned in forging the stress would figure slightly below 11,000 lb. per square inch.

Laminations in the ends of thick steel plates have been found on one or two other occasions by the Kellogg company in its recent experience in making up thick-plate penstocks for high-head work. At the time the Eldorado penstock was manufactured, this difficulty had not been experienced, but it appeared in subsequent work. Such laminations occur at the end of the plate representing the top of the billet, and originate in pipes, slag pockets, or "fishtails" from rolling. Specially careful inspection has been instituted to detect and eliminate such laminations in heavy plate work since their discovery. When they are suspected, the end of the plate is double sheared, the second cut being an inch or so

back of the first cut; any lamination will be revealed by the sliding of one layer on another in the shearing. Examination of etched sections and microscopic study of structure are also used. Laminated sheets have been found to be weak under high bursting stress, because of a tendency to unequal distribution of stress between the different layers, the outer layers seemingly taking highest stress.

Specimens of steel from the ruptured section are to be analyzed and examined micrographically for any further information bearing on the failure.

In order to get the penstock into service as rapidly as possible, some very fast work was done in building, shipping and installing a replacement section. A new rolled steel welding flange was ordered from Pittsburgh immediately on receiving word at Jersey City to proceed. Through the co-operation of another purchaser the flange was received at the Jersey City plant three days after ordering, and manufacture of the new section was begun on Jan. 2. The welding, forging, jointing and annealing, followed by testing to 50 per cent over-pressure, were completed by the evening of Jan. 5. Arrangements had been made to ship the section by express to Sacramento, and on completion the pipe was rushed to the waiting train at Jersey City and started that evening. There was a 20-hr. train delay on the way, but the pipe reached Sacramento on Jan. 10 and from there was immediately trucked to the job, about 60 miles away. By Monday, the 14th, it was in the line and riveted up to the adjoining length, ready for service, and on the following day the plant started trial operation.

Activated-Sludge Progress in Ontario

ONTARIO has 7 municipal and 11 institutional activated-sludge plants, according to information given to *Engineering News-Record* by F. A. Dallyn, director, Sanitary Engineering Division, Provincial Board of Health, Toronto, under date of Jan. 29. The total capacity of the 18 plants is 10,235,000 U. S. gallons daily, the total capacity for the municipal plants being 9,360,000 and of the institutional plants 856,000 U. S. gallons. In addition, there are four projected municipal plants with a combined capacity of 10,475,000 U. S. gallons. Mr. Dallyn states that "in each municipality the entire population, as far as it is sewered, is served by" the municipal plants. The accompanying table shows the municipal installations, their capacity, etc. The 11 institutional plants range in size from 180,000 to 24,000 U. S. gallons daily and serve estimated populations of from 1,300 to 300 each. The earliest of these institutional plants to be installed was put in use at the experimental station of the Provincial Board of Health in 1913, according to Mr. Dallyn.

MUNICIPAL ACTIVATED-SLUDGE PLANTS IN ONTARIO

Municipality	Daily capacity of plant in U. S. gal. Rated Capacity,	Normal Operation	Date of Installation	Population
Woodstock	2,400,000	1,800,000	1921	10,000
Guelph	2,400,000	1,320,000	1922	18,000
Stratford	1,800,000	1,440,000	1923	18,000
Timmins	1,200,000	.....	1920	5,500
Brampton	600,000	.....	1918	4,500
Cochrane	600,000	.....	1923	2,500
Crystal Beach	360,000	.....	1922	6,000
Total	9,360,000			62,500,000

Projected Plants: Newmarket, 600,000 U. S. gal. rated capacity; Kapuskasing 300,000; Peterboro and Welland, 5,000,000 each.

London Water-Works Enlargements

EXTENSIONS to the water-works of London, England, recently completed or under way include several new pumping units, a large reservoir, various intakes and conduits, and double filtration plants. From a description of these improvements contributed to the London *Engineer* of Jan. 11, by Henry E. Stilgoe, chief engineer, Metropolitan Water Board, we take the following information as illustrative of current London water-works practice.

The concrete lining of the inner slope of the embankment of the Littleton storage reservoir consists of 6-in. slabs for the lower portion and of precast rock-faced blocks 2¾ ft. long, 8 in. wide, and 8 in. deep for the upper portion to a depth of about 12 ft. below high-water level. Both the blocks and slabs are held in place by longitudinal concrete toes spaced about 25 ft. apart.

Three Venturi meters with diameters of 4 ft. 10 in. at the throats, and 9 ft. at each end are built into a new intake from the Thames. Each meter is designed for a flow rate of 120 U.S. m.g.d. and is guaranteed to have an accuracy within 1 per cent either way and a loss of head of not over 3 in. The meters are built of mass concrete and are lined with cement. The channels leading to the meters and the conduits just downstream from the meters are closed by "roller sluices."

Of several new pumping plants one at the Thames River intake below Penton Hook Weir consists of four units having a total pumping capacity of 360 U.S. m.g.d. against a head of 37 ft., each unit being a uniflow steam engine driving a single-stage centrifugal pump. At several other points vertical triple-expansion pumping engines have been or are about to be built. At Kempton two units of the type just named, capable of delivering 14.4 U.S. m.g.d. against 400 ft. head or 19.2 U.S. m.g.d. under a head of 300 ft., "the variation in the quantity and head," according to the *Engineer*, "being effected by means of external plungers, which can either be bolted down to the pump casing or attached to the plunger." At Lea Bridge a vertical triple-expansion pumping engine with a capacity of 16.8 U.S. m.g.d. working against a head of 200 ft. is being provided, and at Walton a similar pumping engine of 21 U.S. m.g.d. working under a head of some 250 ft. is being installed. At the last-named station there will be a steam-turbine centrifugal pump, also of 21 U.S. m.g.d. capacity.

Reinforced-concrete conduits of short length, partly 8 ft. and partly 6 ft. in diameter, are being built.

The new filtration plant at Walton will consist of 18 primary rapid or mechanical filters, each ranging in capacity between 1.2 and 2.4 U.S. m.g.d., and 6 secondary filters of the slow sand type, each of the latter having an area of about ⅝ of an acre. The rapid filters will work at a rate of from 100 to 200 Imp. gal. per square foot per hour, or about 125 to 150 U.S. m.g.d. per acre. The rapid filter beds will be placed in tanks of reinforced concrete and the slow sand beds in plain concrete, lined with brick. The flows will be measured by Venturi meters. A somewhat larger mechanical filter plant (24 instead of 18 units) operating at the rates already given is to be started this year at Kempton. Taking the mean of the range of operating rates these rapid filter plants would have total capacities of 27 and 36 U.S. m.g.d., respectively.

From Job and Office

Hints That Cut Cost and Time For the Contractor and the Engineer

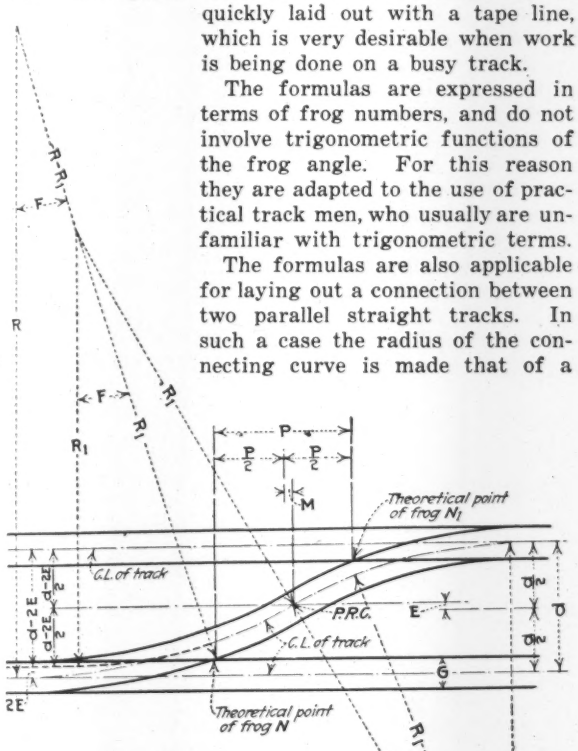
Laying Out Crossovers With a Tape

By A. G. Bennett
Division Engineer's Office, Chicago & Northwestern R.R., Madison, Wis.

WHERE ROOM is limited and other conditions make it necessary to use a crossover having frogs of different numbers with a reverse for the connecting curve, the formulas and accompanying tables here given will be found useful in determining the distance between frogs, and in locating the point of reverse curve. With these points determined the crossover can be quickly laid out with a tape line, which is very desirable when work is being done on a busy track.

The formulas are expressed in terms of frog numbers, and do not involve trigonometric functions of the frog angle. For this reason they are adapted to the use of practical track men, who usually are unfamiliar with trigonometric terms.

The formulas are also applicable for laying out a connection between two parallel straight tracks. In such a case the radius of the connecting curve is made that of a turnout for some number of frog. The formula will give the location of the point of reverse curve, and the point of tangent will be at a distance from the frog equal to P plus the theoretical lead for the frog of the connecting curve used.



CROSSOVER DIAGRAM

The distances M and E are constant for the same combination of frogs for all distances between track centers. This being true, the formulas can be used for computing a connection consisting partly of a tangent instead of a reverse curve. In such case compute the distance between frogs and location of the point of reverse curve for track centers less than d (the centers that are to be used). Then insert a tangent at the point of reverse of length sufficient to make the distance between tracks what is desired. From the sketch it will be seen that length of tangent is equal to the difference between the track centers used in the calculation and the track centers desired, multiplied by the sine of the central angle of curve with radius R_1, which can readily be determined.

The formulas are exact and hold true for curves of very short radii, making them especially useful for street-car track layouts. They are as follows:

N and N_1 represent frog numbers. The connecting curve will have radius equal to that of turnout curve for frog N_1; d equals track centers and gage equals 4 ft. 8½ in.

P = Distance between theoretical point of frogs

$$= 2\sqrt{\frac{113}{6}N_1^2\left(\frac{d}{2}-E\right)-\left(\frac{d}{2}-E\right)^2}-B$$

$$= (\text{When } N=N_1)\sqrt{\frac{113N_1^2d}{3}-d^2}-\frac{113N}{6}$$

(Note:—Use this formula in this case)

M = Distance from mid-point of P to $P.R.C.$ measured to { right for left-hand turnout / left for right-hand turnout } when facing track with the sharper turnout

E = Distance from centerline between tracks to $P.R.C.$ measured toward track with sharper turnout.

TABLE OF VALUES FOR E, M AND B.

Frog N	Frog N_1 4½	5	6	7	8	9	10	
	0.0	—0.55	—1.81	—3.30	—5.03	—6.98	—9.16	E
4½	See note	99.3	130.8	167.7	208.2	252.7	301.4	B
	0.0	2.61	9.39	18.21	29.12	42.15	57.15	M
	+0.44	0.0	—1.03	—2.24	—3.64	—5.23	—6.99	E
5	80.6	See note	124.1	157.7	195.1	236.2	281.2	B
	2.13	0.0	5.63	13.12	22.50	33.70	46.90	M
	+1.02	+0.59	0.0	—0.84	—1.82	—2.92	—4.16	E
6	74.3	86.4	See note	142.7	175.5	211.4	250.4	B
	5.32	3.93	0.0	5.49	12.53	21.18	31.30	M
	+1.37	+1.15	+0.62	0.0	—0.72	—1.53	—2.44	E
7	69.8	80.9	105.0	See note	161.3	193.5	228.3	B
	7.58	6.72	4.03	0.0	5.36	12.10	20.10	M
	+1.60	+1.43	+1.03	+0.55	0.0	—0.62	—0.73	E
8	66.4	76.7	99.0	123.7	See note	180.0	211.7	B
	9.31	8.85	7.06	4.12	0.0	5.29	11.75	M
	+1.77	+1.62	+1.30	+0.93	+0.49	0.0	—0.55	E
9	63.7	73.4	94.3	117.3	142.3	See note	198.7	B
	10.61	10.43	9.42	7.33	4.19	0.0	5.23	M
	+1.87	+1.76	+1.50	+1.20	+0.85	+0.45	0.0	E
10	61.6	70.8	90.5	112.2	135.7	161.1	See note	B
	11.68	11.80	11.31	9.90	7.53	4.24	0.0	M

M, B and E are constant for the same combination of frogs for all track centers and can be taken from table below.

Following is a solution of the problem:

The figure shows a left-hand crossover between parallel tracks on tangent with turnouts N and N_1 connected by a reverse curve having radius equal to that of turnout N_1 (the sharper one of turnout). Track centers equal d. Gage equals G (or for gage of 4 ft. 8½ in. $= \frac{113 \text{ ft.}}{24}$)

It is required to find the distance P between point of frogs and to locate the $P.R.C.$

$2E$ in figure = distance between centerline track and a tangent, parallel thereto, to the connecting curve of crossover produced as shown by dotted line

$$= R - R_1 - (R - R_1)\cos F \quad \ldots\ldots (1)$$

in which R = radius of turnout $N = 2GN^2$
R_1 = radius of turnout $N_1 = 2GN_1^2$
F = angle frog N.

Substitute these values for R and R_1 in Equation 1, and for cosine of frog angle its value in terms of frog number; i.e., $\frac{N^2 - \frac{1}{4}}{N^2 + \frac{1}{4}}$, and when simplified it becomes:

$$2E = 2G(N^2 - N_1^2)\frac{\frac{1}{2}}{N^2 + \frac{1}{4}}$$

From figure, distance mid-point between tracks to *P.R.C.*

$$= \frac{d}{2} - \frac{d - 2E}{2} = E$$

$$= G(N^2 - N_1^2)\frac{\frac{1}{2}}{N^2 + \frac{1}{4}} = \frac{113(N^2 - N_1^2)}{48(N^2 + \frac{1}{4})}$$

(See table of values for E.)

Again from figure we have distance between theoretical points of frogs to be

$$P = 2\sqrt{R_1^2 - (R_1 - \frac{d}{2} + E)^2} - \left(R_1 + \frac{G}{2}\right)\sin F - \left(R_1 + \frac{G}{2}\right)\sin F_1, \ldots (2)$$

Substituting for R_1, sin F and sin F_1 their values as expressed in terms of frog numbers, i.e.,

$R_1 = 2GN_1^2$

$\sin F = \frac{N}{N^2 + \frac{1}{4}}$ (F being angle of frog N)

$\sin F_1 = \frac{N_1}{N_1^2 + \frac{1}{4}}$ (F_1 being angle of frog N_1)

and when simplified Equation 2 becomes:

$$P = 2\sqrt{4GN_1^2\left(\frac{d}{2} - E\right) - \left(\frac{d}{2} - E\right)^2} - 2G(N + N_1)\frac{NN_1 + \frac{1}{4}}{N^2 + \frac{1}{4}} \quad \ldots\ldots (3)$$

Then for G = standard gage of 4 ft. 8½ in. = $\frac{113}{24}$ ft.

Equation 3 becomes:

$$P = 2\sqrt{\frac{113}{6}N_1^2\left(\frac{d}{2} - E\right) - \left(\frac{d}{2} - E\right)^2} - \frac{113(N + N_1)(NN_1 + \frac{1}{4})}{12(N^2 + \frac{1}{4})} \quad \ldots\ldots (4)$$

In Equation 4 let expression

$$\frac{113(N + N_1)NN_1 + \frac{1}{4}}{12(N^2 + \frac{1}{4})} = B.$$ (See table for values of B.)

And Equation 4 becomes

$$P = 2\sqrt{\frac{113}{6}N_1^2\left(\frac{d}{2} - E\right) - \left(\frac{d}{2} - E\right)^2} - B \ldots (5)$$

Again referring to the figure,

$$M = \sqrt{R_1^2 - \left(R_1 - \frac{d - 2E}{2}\right)^2} - R_1 - \frac{G}{2}\sin F_1 - \frac{P}{2} \quad \ldots\ldots (6)$$

Substituting and simplifying Equation 6 and

$$M = \frac{113(N - N_1)(NN_1 + \frac{1}{4})}{48(N^2 + \frac{1}{4})}$$ (See table of values for M.)

From Job and Office

Hints that Cut Cost and Time

Chart Gives Cast-Iron Pipe Costs

By James R. McComas
Assistant Sanitary Engineer, Maryland State Department of Health

THE accompanying chart, for determining the linear-foot cost of cast-iron water pipe, will be found convenient and useful in determining unit costs

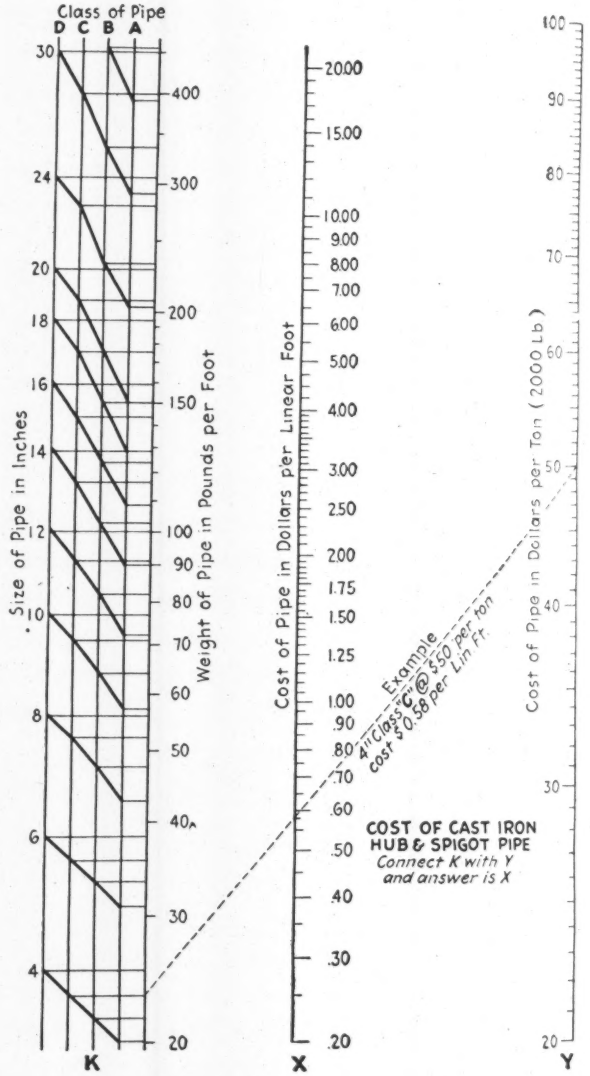

Class of Pipe
D C B A
Size of Pipe in Inches
Weight of Pipe in Pounds per Foot
Cost of Pipe in Dollars per Linear Foot
Cost of Pipe in Dollars per Ton (2000 Lb.)
Example
4" Class C @ $50 per ton
cost $0.58 per Lin. Ft.
COST OF CAST IRON
HUB & SPIGOT PIPE
Connect K with Y
and answer is X
K
X
Y

CHART OF CAST-IRON PIPE COSTS

for any size and class of American Water Works Association standard hub and spigot pipe at any price per ton. Special advantage is offered by the chart to the field engineer and to the contractor; who, by remembering the current price of pipe per ton, may determine immediately and with sufficient accuracy by this chart the required results. The various steps follow:

From Job and Office

For Contractor and Engineer

Connect the weight per linear foot of pipe of any desired class, as shown on Line *K*, with the current price on Line *Y*, and read result on Line *X* as shown by the example.

Automobile Operating Costs Affected by Condition of Roads

By J. T. Madison
Assistant Engineer, Kentucky Highway Department, Frankfort, Ky.

From the reports on 60 Ford cars operated by the Kentucky Highway Department during 1922 and 1923, a study of the effect of road conditions on the cost of operation and upkeep of automobiles was recently made. This was done to determine how much less it cost to operate an automobile over a good road than over a poor one. The cost of operation and upkeep includes all expenditures for gasoline, oil, tires, repairs, renewals, and storage; other items constituting legitimate charges against the automobile were included under these headings.

Under good roads were included all high-type pavements, waterbound macadam and gravel in a reasonably good condition. The total miles traveled by the 36 Ford touring cars operating over these roads was 170,794; the total cost for operation and upkeep was as follows:

Item	Cost	Percentage of Total Cost
Gasoline	$2,907.57	36.34
Oil and grease	526.51	6.58
Tires	745.83	9.32
Repairs	3,031.85	37.91
Storage	787.39	9.85
Total	$7,999.12	.....

* Average cost per mile excluding storage $0.0422.

Poor roads include unimproved earth or rock roads, such as are found in many counties of eastern and western Kentucky. Many of these are impassable to automobile traffic during some of the winter months. There were 24 Ford automobiles of the touring type reported under this heading. They operated a total of 98,246 miles at a total cost as follows:

Item	Cost	Percentage of Total Cost
Gasoline	$2,308.68	31.43
Oil and grease	557.33	7.59
Tires	792.55	10.79
Repairs	2,951.06	40.17
Storage	735.39	10.02
Total	$7,345.01	.....

Average cost per mile excluding storage $0.0672.

It is found from the average cost per mile for the two classifications of roads that traveling over poor roads costs $0.0250 per mile in excess of that over good roads.

When making comparison between percentages for any item such as gasoline, under the headings of good and poor roads, it must be remembered that nearly twice as many miles were traveled on good as on poor roads, so that the average cost per mile for gasoline on good roads was $0.017 and on poor roads $0.023.

Cradle for Drain Tile in Quicksand

By A. Griffin
Canadian Pacific Ry. Co., Brooks, Alberta

A useful arrangement for laying drain tile in quicksand is shown by the accompanying views. These illustrate the construction of an 18-in. diameter tile drain through saturated quicksand. The writer had in 1913 and 1914 been in charge of the installation of similar tile drains on the Newlands Reclamation Project in Nevada. The drains there were from 12 to 18 in. in diameter and were constructed of vitrified tile.

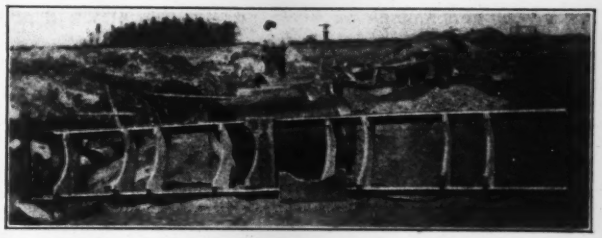


FIG. 1—CRADLE SUPPORTS TILE IN QUICKSAND DITCH

A great deal of trouble was experienced due to the difficulty of making joints which would keep out the fine quicksand, drains being at times rendered worthless.

At that time we followed the practice of covering the top two-thirds of the joint with burlap and in cases where the cracks appeared too wide, strips of galvanized iron were placed over the joint before the burlap. Even then it was found that the saturated quicksand would eventually tear the burlap or would run into the pipe through very small holes, while in other cases it got into the pipe from below, leaving considerable cavities under the line. The result was that the pipes were filled with sand and were subject to displacement in any direction, and in some instances actually fell into cavities below a distance of 30 in. or more.

Therefore in the case of the tile line under discussion, which was some 3,000 ft. in length, the writer decided to use vitrified sewer pipe which was all laid on a ladder constructed of 1x6-in. lumber set on edge with cradles between as illustrated in Fig. 1.

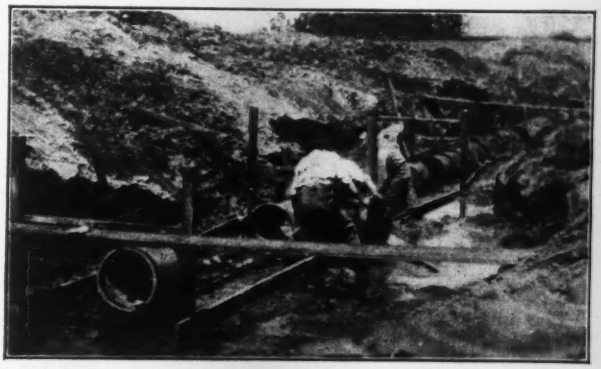


FIG. 2—LAYING DRAIN TILE ON TIMBER CRADLE

After the ladders were set to line and grade the pipe merely had to be set on them as illustrated in Fig. 2. It will be noted that the joints occur between the two cradles which are close together. As soon as the pipes were placed, this space was filled with crushed rock. The top two-thirds of the joint was then cemented, after

which a small wooden form was set against the joint and filled with crushed rock on the inside and backfilled on the outside with sand. The long space between the cradles was also packed tightly with sand and the small forms were withdrawn. By this means the top two-thirds of the joint was cemented and made watertight and the bottom half was closely packed with crushed rock through which the quicksand did not travel.

This was rather an expensive method of laying a tile drain, but it seemed justified by my previous experience with tile drains and has been fully justified by its performance.

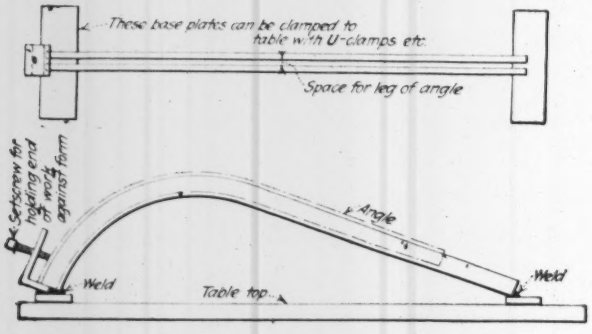
This drain was installed in April, 1917, and as late as a year ago had never given any trouble and had not required any maintenance.

Bending Form for Structural Steel Parts

By C. W. Cyphers
Scotia, N. Y.

THE BENDING form for shaping structural steel parts herewith pictured is suggested because of its extreme economy in labor and materials. It also supplies a product uniform in appearance and dimensions. Its range of utility can be broadened beyond illustration by making one member alone stationary. It eliminates expensive machining of rollers, handles or dies, and is entirely portable in that it can be clamped or laid on anything sufficiently solid.

The essential parts of the bending form are parts *A*, which are alike and previously bent to desired dimensions; part *B*, which can be bent or can be made from a piece of unequal leg angle and tapped for a set screw, part *C;* and parts *D*, which are flat strips and are used as tie plates and bases. Assembly is made by welding the parts together as illustrated. Dimensions for this


These base plates can be clamped to table with U-clamps etc.
Space for leg of angle
Set screw for holding end of work against form
Angle
Weld
Table top
Weld

BENDING FORM FOR STRUCTURAL SHAPES

fixture as used by the writer were as follows: Part *A* 1¾ x ¾ in.; part *B*, 2 in. x ½ in.; part *C*, ½-in. diameter, and part *D*, 2 x ½ in.

The article to be bent can be preheated for the length wherein the bend is to take place. By preheating, considerable increase in quantity of finished shapes can be obtained as a single man can be bending three or four while he is heating another batch of the same number in a forge or furnace. The physical force involved is obviously less on heated charges than on a charge cold bent, though the latter charges are cheaper when only a few are required.

From Job and Office

Hints that Cut Cost and Time

Steep Embankment in Tacoma Made by Slow Filling Process

STADIUM WAY, a roadway in Tacoma leading from B St. toward the Tacoma stadium, was recently opened to traffic over a high fill with a very steep face. The fill was built up by degrees during a period of three years at very low cost to the city and consists entirely of material excavated from building sites which the city permitted contractors to dispose of by

STEEP FACE OF FILL MADE FOR TACOMA STREET

dumping at this point. This plan had the advantage that the cost to the city for the fill proper was practically nothing, and since there were no funds for doing the work otherwise no valid objection could be raised to the slow rate of progress.

As the material was placed gradually the fill was made very compact by simply keeping pondage behind it and maintaining the outer edge of the dump higher. The material compacted so well that a slope of 1½ to 1 for a maximum height of 85 ft. was found practicable with nothing but the loose sand, gravel and clay as delivered from excavations nearby. The materials were inspected in each case before a dumping permit was granted and no rubbish or other unsuitable matter was accepted.

Very little settlement has occurred since completion of the fill; in fact, shortly after it was opened to traffic its lower end was paved with concrete. The top of the fill is 60 ft. wide, and the paving was made 30 ft. in width. The higher portion of the fill, which has been given a little more time to settle before paving, has been covered with planks to prevent surface wear.

Before the fill was started the toe was secured by a timber crib retaining wall 12 or 14 ft. high, and with the protection thus afforded the city later built a reinforced-concrete retaining wall to a height of 32 ft. above a lower street level, as shown in the accompanying picture. This wall is 12 ft. wide at the bottom and the outer edge of its base is supported on piles. It was designed as a slab with pilasters on 8-ft. centers.

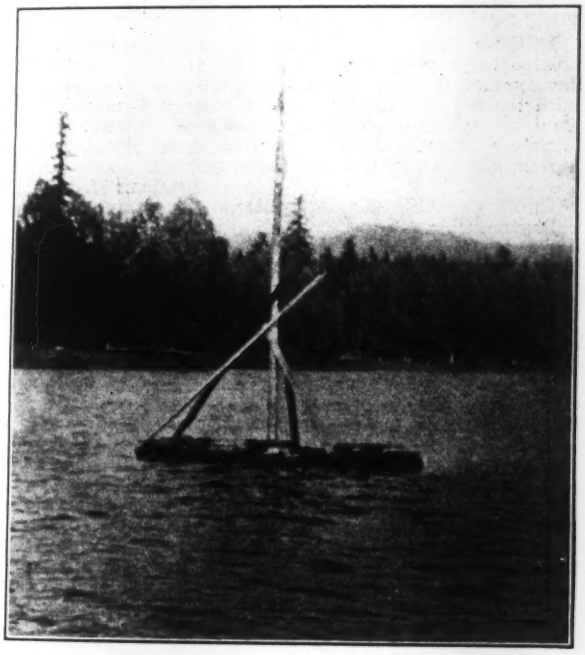
From Job and Office

For Contractor and Engineer

Pontoons Support Telephone Poles

A NEW application of pontoon bridge construction has been made in the Santiam National Forest, Oregon. Great difficulty was experienced in causing a telephone line to hold up in crossing a mountain lake. The first efforts were devoted to setting poles in the lake bottom, a method to which the shallow water seemed to promise stability. However, during the severe winters ice dragged the poles out of place and left the wires stranded in the water.

The telephone line was an essential factor in the fire protection system of the forest and it was found necessary to devise some means by which the poles could be given permanent stability. Under the plan devised by a Forest Service fire chief the poles were mounted on rafts made of large logs. Each raft was anchored



TELEPHONE POLE SUPPORTED ON PONTOON

by heavy stones and wires. To overcome the motion of the waves the wires were attached to the poles by swinging insulators. This winter has left the line unharmed and the plan has enabled the maintenance of constant telephone communication among the fire fighting forces.

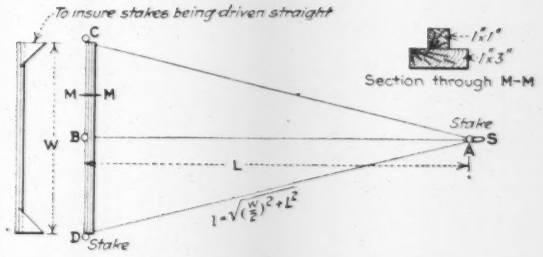
Templet for Setting Grade Stakes

By Frank E. Harley

Assistant Engineer, N. J. State Highway Department, Dover, N. J.

IN SETTING stakes for fine grading the templet herein shown was devised by the writer. A chain, tape or wire of length $l = \sqrt{\left(\frac{W}{2}\right)^2 + L^2}$, in which W is the width of the road and L the distance between stations, is stretched from C and D to A, at which point also a wire loop S is attached.

The loop S is placed over the center stake at the forward station, which in this case is A, and the templet is then centered over the stake at B. Two men then drive stakes at C and D.



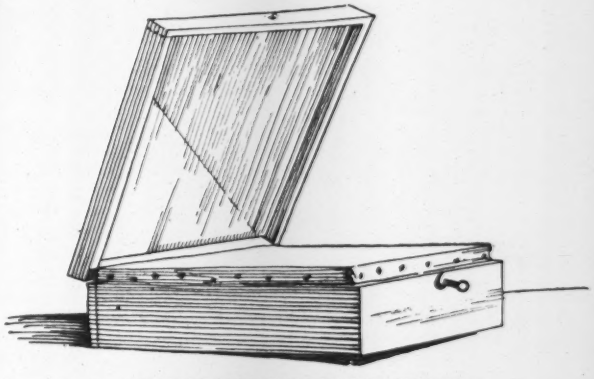
DETAILS OF GRADE STAKE TEMPLET

Though the use of this templet requires the assistance of four men, any sort of labor will do. The writer used it in road construction in Santo Domingo with four untrained peons.

Job and Office Notes

Novel Use to Which Construction Forces put an auto truck in the laying of a 10-in. pipe line 40 miles long for a western gas refining company is told in a recent issue of *Oxy-Acetylene Tips*. Inasmuch as part of the work was in rough country many pipe sections had to be bent. A motor truck served as the means of making such bends. In making side bends the pipe was continued about 50 ft. past the point where the bend was needed. The point was then anchored to the ground, the truck hooked to the open end of the line, and a slow, steady pull in the direction desired made the bend. Over bends were made by placing blocks under the line at the point of bend. Planks, 3 in. x 12 in. x 18 ft., served as wheel tracks whereon the truck mounted the line. By running the truck on the planks until the front wheels were just over the line, and with the added weight of the working gang, the bend was made.

Turning a Cigar Box Into a Blueprint frame is what B. M. Ranow, Scranton, Pa., has done as shown herewith.



HOME-MADE BLUEPRINT FRAME

The device is simple in arrangement, a cloth stretched across the box and securely tacked, providing the background upon which the blueprint paper rests.

Letters to the Editor

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

Criticism of "New Logarithmic Equation for Friction Losses in Pipes"

Sir—In your issue of Oct. 11, 1923, p. 605, is an article by F. W. Greve, associate professor of hydraulic engineering, Purdue University, Lafayette, Ind., entitled "New Logarithmic Equation for Friction Losses in Pipes" in which he says (referring to formulas for the determination of friction losses in pipes): "All of them, no matter what the type may be, depend upon coefficients which vary with the diameter and length of pipe, velocity of flow, etc." He then proceeds to offer a formula which purports to eliminate the objections of existing formulas.

Professor Greve is apparently not familiar with the extensive literature on the subject of flow of water in pipes else he would know that his formula is not new and that there are many formulas whose coefficients do not depend upon the length or diameter. The formula for iron pipe of moderate age as finally developed by him is

$$h_f = 10.96 d^{-1.169} v^{1.85},$$

which he evolves "to a large extent" from values given in Hazen and Williams' "Hydraulic Tables."

This is not a new equation. Many of this form have been devised before. A few examples (using the same nomenclature and form) are: The writer's formula for wood pipe,

$$h_f = 8.6 d^{-1.26} v^{1.8},$$

first published in 1912; Scobey's formula for wood pipe,

$$h_f = 7.68 d^{1.17} v^{1.8},$$

published in 1916; Williams' formula for all kinds of pipe,

$$h_f = 8.6 d^{-1.25} v^{1.87},$$

devised about twenty years ago. For the enlightenment of those who might be misled or possibly place too much confidence in the alleged "new equation" the writer feels that Professor Greve's statement quoted above should not be allowed to stand unchallenged.

The formula offered by Professor Greve is quite useless. It has nothing to recommend it that is not already embodied in well-known existing formulas, for the solution of which tables or diagrams are generally available.

Effingham, Ill., Dec. 15, 1923.

E. A. Moritz, Consulting Engineer.

Definition of Hydraulic-Fill Dam

Sir—The editorial in *Engineering News-Record*, Feb. 7, p. 222, on "Hydraulic-Fill Dam Nomenclature" is timely and to the point.

The term hydraulic fill has been used very loosely, and while distinctions have been made at various times in the past between hydraulic fill and semi-hydraulic or modified hydraulic methods, notably in the specifications of the Miami Conservancy District, there is still confusion in the minds of many engineers who have not been closely familiar with the different methods and results.

In the writer's opinion a true hydraulic-fill dam is one in which the materials are brought to the dam and distributed to their final position in the dam, by means of flowing water; if the materials are brought to the dam by any other means than that of flowing water, it is not a true hydraulic fill; but dams into which the material is either sluiced or pumped may be included in the true hydraulic-fill type.

In a discussion of a paper in *Transactions*, Am. Soc. C. E., Volume 85, page 1215, Joel D. Justin suggested the following definitions:

Hydraulic-fill Dam. An earth dam, in the construction of which the materials are transported and distributed by water to their final position in the dam.

Semi-hydraulic-fill Dam. An earth dam, in the construction of which the materials are transported on the dam by other means than water, dumped within the section of the dam and some of this material moved to its final position in the dam by the action of water.

Those definitions give the distinction between the two types of fill, and in the writer's opinion answer the purpose very well. Whether material is sluiced into a dam or pumped makes no difference in the character of the fill. The results, as far as the fill itself is concerned, are exactly the same. Therefore there seems to be no good reason for trying to make a distinction there.

On the other hand, as between bringing the material onto the dam by water or in a dry state, there is a difference in character of fill (regardless of preference as to results), and the definitions of types should make a distinction as Mr. Justin's do.

The following might be taken as somewhat more specific definitions:

Hydraulic-fill Dam. One in which the materials are brought to the dam, and laid down in the embankment, by means of flowing water, and manipulated in such manner as to segregate the fines, within a predetermined section, to form an impervious core.

Semi-hydraulic-fill Dam. One in which the materials are put into the embankment by some means other than by flowing water, and then worked over or manipulated by means of water, in such manner as to separate out and segregate enough of the fines, within a predetermined section, to form an impervious core.

If these definitions are accepted, and in the writer's opinion they agree in a general way with the ideas which are common in the minds of engineers who have had to do with the design and construction of such dams, then the Davis Bridge Dam would be classified as a semi-hydraulic structure. So would the Tieton Dam in the state of Washington, and that, by the way, is 244 ft. high.

Charles H. Paul, Chief Engineer, Miami Conservancy District.

Dayton, Ohio, Feb. 11, 1924.

Reclamation Troubles and Engineering

Sir—You have been doing a valuable public service in taking up the subject of the reclamation problems and endeavoring to provide public information on their many-sided complications. It was my pleasure to serve the Reclamation Service for 10 years, and, though my work was construction, I did see many of the difficulties of the settlers and the vexatious problems of the project operating managers. I wish to testify to the ability, honesty, and conscientious economy which permeated all ranks of the personnel, from bottom to top, and to the high grade of service rendered by it.

It seems a great pity that the Service cannot continue to benefit by the guidance of such eminently qualified and experienced men as have heretofore directed its destinies. Dr. F. H. Newell, the dean of the Service, and considered by those who have been intimately associated with it as the real father of the Reclamation Service, was the first to go, some eight years ago. His loss was quickly followed by that of L. C. Hill, E. G. Hopson, and H. N. Savage, his able lieutenants and associates in the pioneering period, who were largely responsible for the well planned and efficiently executed work of construction which brought fame to the Service during the period of its greatest activity. Now comes the loss of A. P. Davis. One wonders how soon this will be followed by the loss of the Denver and Washington staffs, and of the consulting engineers. Of course the logical end of Secretary Work's policy is the elimination of all the engineer project managers—men who have grown up with the Service and have gained valuable experience, not to mention their excellent service for these many years.

While I am an engineer, I believe I am able to see the many sides of the reclamation difficulties. Secretary Work and his predecessors have had, and his successors will always have, a difficult and knotty problem. As to the engineers themselves, sentiment need not be wasted on

them, as most of them will do much better out of the Reclamation Service. But what hurts is that their work should be maligned; and this really is not necessary.

You cannot wholly eliminate politics from any large public works. Any policy of the government naturally becomes a matter of politics, and therefore it seems necessary that the responsible head of any public service shall be a man who is amenable to the votes of the people—not necessarily of a small minority, but of the people as a whole. And the reclamation farmers have much to gain if by constant agitation and complaint they can eventually escape the payment of some $130,000,000 of construction costs of the projects, for which they are now legally obligated. Are they going to lose any opportunity to raise a howl whenever opportunity offers? Rightly or wrongly, people look upon dealings with their government quite differently from the way they look upon dealings with individuals.

The first mistake of reclamation was the Congressional creative act. Would it not have been much better if the general government had never undertaken to collect from water users' associations? It seems to me that if Washington had required the state to stand between, to do the collecting and be responsible, and refund the costs of their respective projects, it would have eliminated many of the present difficulties—for politicians, as well as for engineers. Is not the machinery as well as the politics of a state much better suited to deal with such matters?

If such an arrangement had been the wiser one at the beginning, it is not now too late to say to the states: "Here, we are tired of having your petty reclamation politics injected into national politics upon every occasion. You take the financial obligations of your respective projects upon yourselves, get your money back any way you choose, and from this date on operate them yourselves. Otherwise we will stop spending money for the improvement of your state, and we will enforce the existing law to the letter." Would not the politicians of both parties be glad to get out from under this periodical bombardment from the reclamation farmers?

As to the success of reclamation, many things might be said. When some of the projects were being constructed and contractors were paying $20 a ton for alfalfa hay, and outside prices plus freight for oats, it was comparatively easy to figure out a competence within a few years from growing oats and hay on land having a water-right cost of say $60 per acre. But now, when the farmer must sell his hay and oats at outside prices minus freight, the situation is very different, and success depends upon producing something that yields a greater return per acre. Any farmer should know that he can't go out into the Rocky Mountain country and pay $50 to $75 per acre for a water right and produce crops in competition with Iowa, to be sold in the national market. Yet, strange to say, such a mistaken belief is the greatest trouble with reclamation today.

Irrigation farming is not easy. The idea of being able to turn on the water whenever the crop shows the need for moisture is captivating to the average farmer who has never had to get out early and work late in rubber boots, wading in the mud with a shovel and a hoe to inveigle the water upon the high places and to get an equable saturation of the field—only to discover in the end that the acreage per man must be cut in half and that crops will not grow from the use of water alone. To some, also, it seems to be an eye-opener to learn that even your irrigated land must be manured, rotated in crops, and scientifically farmed, in order that its productive qualities may be conserved. And drainage has never even entered the farmer's head. So, when he does learn all of these things from sad experience, he is quite apt to wish to return to Iowa or Illinois, of which the Lord thinks enough to rain upon them periodically, and where a strong back and a weak mind can produce greater returns.

Considering these conditions, is it any wonder that a large number of the reclamation farmers are misfits, and after years of pioneering are in debt and are ready to place the blame of the failure upon the Reclamation Service? I myself have had some experience at farming irrigated land. At one time my periodical back-to-the-soil urge induced me to purchase a farm of 47 acres irrigated by a company project. I purchased the place with a view to influencing the improvement of the project and selling, but thus far I have been unable to exert much influence in the direction of improvement, and I have found no one who values the place as high as I did some ten years ago. And I will add that if some of the contentious reclamation farmers had had my experience with this farmer-managed ditch they would have a far greater appreciation of the Reclamation Service and its many advantages.

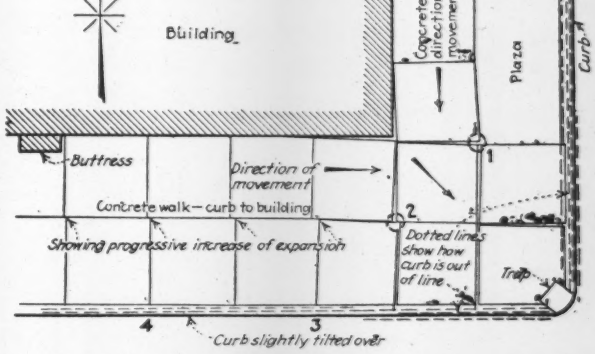
If engineers in the Service should not overlook the politician's viewpoint, it is just as important a demand that politicians, when they get into trouble, should not start mudslinging at the engineers. If they do, the engineers should get out of the Service, and through their organizations, assisted by *Engineering News-Record*, make them sorry they started it. No engineer in any government service should consider himself wedded to his work. He should insist upon decent pay or get out; a grateful government will never recognize his fidelity and reward him for faithful service with honors and a big salary when he has grown lean and gray after long toil on a pittance. It is more likely to give him a kick in the ribs and send him to the scrap heap. His only safe rule is that when he is mistreated, by politics or otherwise, he should get out and raise all the hell he can—for the benefit of the Service.

Above all, it is necessary to revise the law so as to make the states benefited responsible for the collections and for the operation of the projects. It is a first necessity that petty politics inherent in the present Reclamation Service duties and responsibilities be eliminated from the national government.

JOSEPH WRIGHT,
Dwight P. Robinson & Co.
Fortaleza, Ceara, Brazil, Dec. 26, 1923.

Expansion Joints in Concrete Pavements

Sir—Besson, in "City Pavements" McGraw-Hill Co., 1923, pages 91 and 92, says, "Detrimental results of compressive stresses in pavements due to the tendency of concrete to successively contract and expand are not directly proportional to the length of construction. In long



EFFECT OF JOINTS IN MOVEMENT IN SIDEWALK

continuous stretches of sidewalk the effect of longitudinal expansion is negligible, for the reason that the walk is held in position by its own weight and friction on the soil subbase. Accordingly it is unnecessary to place soft mastic transverse joints in sidewalks. Often curb at street corners is pushed out of line and usually the movement is ascribed to expansion in a long stretch of sidewalk, whereas in reality the long stretch sticks to its position, and as shown in Fig. 44, a 6-ft. length from the curb to the main walk is the cause of the trouble, etc., etc."

Mr. Besson's arguments are not well taken and his conclusions apply only to the case illustrated, even if to that case. Proof of this follows. At 1 (see sketch) the slab on the north and south street has moved at least 2 in. At 2 the slab on the east and west street has moved at least 2 in. Looking north across the sidewalk at 3 and 4 on the east and west street, shows that the outer section

of the slab has moved further than the inner section. The reason for the lesser movement of the inner slab is the friction of the walk against the building and the building buttress as shown in the plan sketch. The inner slab was poured immediately adjacent to and around the buttress thus allowing for no movement whatever. The movement that did take place was from the buttress to the corner.

The entire curbing shown on the east and west street in the plan is slightly pushed over to the south by the transverse expansion in the width of the sidewalk (about 12 ft.). The entire slab has had a tendency to ride the curb and is perceptably higher than the curb at present. At the corner as shown in dotted lines on the plan the curb has been pushed out of line about 3 in. both to the east and to the south.

There are no expansion joints other than the hand-cut and sand-filled joints in the base even if that much precaution was taken against expansion. The slab is made of the regular two-course work with a 1:3:5 base and a 1:1 finish coat.

M'KEAN MAFFITT,
Superintendent of Public Works.

Wilmington, N. C., Jan. 16, 1924.

On the American Engineering Council

Sir—The brief editorial in your issue of Jan. 24, 1924, relative to American Engineering Council, I trust, has opened your columns to comment upon this subject of vital consequences.

The attitude of *Engineering News-Record* for the past two years has been so critical of American Engineering Council that to respond has seemed useless to those who believed such criticism to be mistaken.

Your editorial shares the vision of what such an organization should be, but lends little help toward reaching it.

Engineers, like other men, busy with their own affairs, rapidly forget things which are not close to themselves. Will you grant the space, therefore, to recall certain facts of recent co-operation history?

Early in 1917, the four national societies formed a committee to deal with matters common to engineers, and named it Engineering Council.

For months it drifted without funds or policy, during which time it was criticised both for doing too little and attempting to do too much. A modest budget having been furnished by the four societies, a live secretary was employed and the Council undertook serious work, the most prominent of which was the establishment of a National Service Committee in Washington—the funds for which were chiefly supplied from outside the budget of Engineering Council. By so doing it started the campaign for a Department of Public Works, which has been influential, and promises early enactment.

Members of the Council speedily recognized that unless it attracted to itself other engineering bodies than those of the four founder societies it could never attain in the esteem of the nation the dignity of representing the entire profession. It therefore offered a plan by which local and other engineering societies might be admitted to membership. No local societies accepted and but two or three national organizations.

Evidently recognizing this, during 1919, so-called Development Committees were named from each of the four founder societies to consider among other things the establishment of an organization which should attract to its membership the great body of engineers of the country. This committee served diligently for many months, the representatives of the American Society of Civil Engineers being of its ablest and most influential elements. It might even be said that they dominated it.

A plan was drafted for a comprehensive organization, to form which a meeting was called at Washington in June, 1920. Delegates came from sixty-one societies: local, state and national.

Authorized representatives of Engineering Council announced its entire willingness to dissolve and leave the field to the more comprehensive organization. This was done without any known or expressed opposition on the part of any of its members at that time.

The enthusiasm of this meeting was high, and vision of a great future of service for the profession inspired those present, while the representatives of the technical journals filled many columns with appreciative and hopeful comment.

Engineering News-Record of June 10 and 17, 1920, carried cordial editorials, from the last of which the following is an excerpt: "If the voice of the engineering profession is to be heard—and the importance of its message both to the country at large and to engineers individually was emphasized by practically every speaker at the recent Washington meeting—engineering societies, national, state, regional and local, must get behind the federation and give it their unqualified support. Before the new organization great opportunities lie."

The delegates of the American Society of Civil Engineers and the American Association of Engineers had made known that they were without authority to commit their organizations to membership. Ultimately both—the most conservative, and the most radical—declined membership.

Proceeding without them, under the leadership and inspiration of great engineers—and incidentally, the first two presidents were members of the American Society of Civil Engineers—American Engineering Council has since been functioning. If it has failed to realize the enthusiastic visions of its founders, it is no more than might have been expected in the absence of the leading and oldest society of our profession. That it has done much is well known to those who have shared its activities.

It has drawn to its membership twenty-three local and state and five national societies.

Included in the results of its work has been the development of the young men who have come as delegates from the local societies. They have worked and grown under it. The societies they represent have broadened in their vision of the profession and its problems. Those which are in its membership are its most enthusiastic supporters.

When it is noted that the latest estimate of the number of engineers in the United States is 146,000, while the membership in the founder societies in 1923 was only 46,500, or practically one-third of the total, it is self-evident that no organization which fails to draw the two-thirds to itself can ever fully represent the engineers of this country; and, still further, without them no such organization can wield its proper public influence.

It may be mentioned that nine of the representatives of the local societies in American Engineering Council are members of the American Society of Civil Engineers.

Engineers who desire that the profession shall be of public service, but who have permitted the critical to dominate their views, might well consider if it is better to let matters drift until American Engineering Council shall further disintegrate and then attempt to reorganize a body which will duplicate the original Engineering Council; or if it would not be wiser to resume their interest in the existing organization and, by sending to it representatives of vision, take its control and correct the deficiencies which you and others have seen. Nothing seems clearer than that if American Engineering Council shall be allowed to dissolve, the profession will have discredited itself before the world.

Whatever criticism may lie, whatever sins of omission or commission may be charged against American Engineering Council, the fact remains that it does hold a place in Washington and before the public which it has well earned and which no other body approaches. It is entirely possible to destroy it, but the building of a successor will require years of time and strain. No organization was ever more amenable to constructive criticism. It is a case where teamwork is needed. The failure to utilize the start already made indicates a degree of intellectual myopia much to be regretted.

In conclusion, I take pleasure in quoting the words of Mr. Hoover, which you have so warmly commended:

"It is precisely for this reason that I am anxious to see Engineering Council continue and grow strong, because unless we have some central point that at least keeps the lamp of public service and relationship alight in the engineering profession, we shall go back into the dark ages where we were twelve years ago in our perhaps hermit-like attitude toward public service and questions."

BAXTER L. BROWN,
Civil Engineer.

St. Louis, Mo., Jan. 31, 1924.

News of the Week

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

Engineers Would Better Chicago Transport

Western Society Approves Proposals of Local Committee Presented at Annual Meeting

A list of recommendations for the improvement of Chicago's local transportation facilities has been approved by the Western Society of Engineers on the basis of a report presented by its committee on local transportation at the conference noted in *Engineering News-Record*, Feb. 14, p. 297. These recommendations may be summarized as follows:

1. Construct a limited system of subways and expand the elevated and surface lines, with bus extensions where desirable, to form a comprehensive and unified system, with a single primary fare (based on cost of service) and free or paid transfers. Consolidate and co-ordinate all surface and elevated lines. Limit rate of expansion to demands of traffic.

2. A comprehensive system of subways is impracticable, owing to the extent of territory, low density of population and high cost. Elevated railroads should be the standard for the city's rapid transit, owing to lower cost. The proper function of subways in Chicago will be to accommodate elevated trains and surface cars in congested districts.

WOULD USE CITY'S CREDIT

3. Unless financial and legal conditions can be so changed as to attract private capital, the credit of the city must be used to acquire the present surface and elevated lines. If the unified system is financed by the city, operation should be by a private corporation under lease, supervised by a board of commissioners. These commissioners should have long tenures of office and should be selected from the financial, engineering and commercial fields.

4. In the district south of the loop or business district, the river should be straightened, new through streets opened and railway facilities rearranged. Additional transportation facilities should be provided in an area surrounding the loop district.

5. Reduce the allowable height of buildings in order to decrease the maximum density of occupation. Complete the paving through the outskirts of the city of the arterial streets necessary to connect with state and county highways. Improve the use of street space by reducing parking privileges, widening roadway at loading points and providing a co-ordinated system of through streets. Route through traffic to avoid congested centers. Separate street and railroad grades when traffic requires.

6. Make further investigation of the following: (A) the use of steam railway tracks and land in connection with rapid transit; (B) the use of subway or elevated sidewalks and arcades in the loop district; (C) the reduction of downtown terminals and loops on the street car lines; (D) provision of parking space in the vicinity of the business district; (E) the policy of fixed bridges instead of drawbridges over the Chicago River, with provision for barge terminals, and (F) the use of the special assessment system to meet cost of construction of transportation facilities in excess of that which would be supported by a reasonable rate of fare.

Federal-Aid Funds Available

By providing an appropriation of $17,700,000 for federal-aid highways during the coming fiscal year, the Committee on Appropriations of the House of Representatives has approved the amount requested for that purpose. This amount is all that is necessary, when added to unexpended funds already appropriated, to provide $85,000,000 which it is estimated is all that can be expended during the next fiscal year. If the road program should proceed more rapidly than is anticipated, further funds could readily be made available by bringing in a deficiency appropriation bill. The status of federal aid funds as prepared by the appropriation committee is as follows:

Total of appropriations available to the States since 1917		$392,817,500 00
Paid to the States, Dec. 31, 1923		284,380,339 58
Balance, Jan. 1, 1924		$108,437,160 42
Estimated expenditure during remainder of fiscal year 1924, at the rate of $6,000,000 per month (6 months)		36,000,000 00
Estimated balance, June 30, 1924		72,437,160 42
Appropriation recommended for 1925 in the accompanying bill		13,000,000 00
Plus unexpended balance on hand, June 30, 1924		72,437,160 42
Total available for expenditure during the fiscal year 1925		85,437,160 42
Estimated expenditure during fiscal year 1925		85,000,000 00
Estimated balance, June 30, 1925		$437,160 42

Court Dismisses Suit Against Stone & Webster

Federal Judge Duvan West, at San Antonio, Texas, has dismissed the government's $3,000,000 suit against Stone & Webster involving a claim for damages for alleged wartime waste in building Camp Travis at San Antonio. At the earlier hearings on the case, Judge West notified the government attorneys that the petition was vague and indefinite and postponed the hearings in order to give them time to prepare a specific petition. At this hearing, Judge West declared that the petition was still too general in character and did not name any specific cases and consequently would be dismissed.

District Attorney John Hartman gave notice of appeal of the case.

Wisconsin Engineers Meet at Madison

Registration Still Sought—Super-Power Fallacies Exposed—Dozen Subjects Discussed

Engineering News-Record Staff Report

Trends, improvements and status in the various branches of engineering were stressed at the sixteenth annual convention, Feb. 21, 22 and 23, of the Wisconsin Society of Engineers at Madison. Membership has increased from 231 to 282 during the year, and L. S. Smith, secretary, reported a cash balance of $900. More than 225 attended the dinner session with the Technical Club of Madison although the regular attendance was somewhat less than 100. Punctuality and a time schedule were strictly adhered to, giving ample time for discussions which practically every one of the dozen subjects presented received.

The former engineers' registration bill, minus the provision for surveyors, will be presented to the 1925 legislature. This is an amendment to the architects' law to include the engineers and does not require an additional board. Another resolution supports any move toward the elimination of stream pollution.

The livest discussions followed Egbert Douglas' paper on "Super-power vs. Coal Conservation" and S. J. Miller on "Improved Vibrolithic Concrete Pavement." Mr. Douglas challenged the claims of coal-saving by central station and super-power advocates because they ignored the heat losses. Vibrolithic does not meet with the approval of the state highway engineers because of the excess of fines brought to the top with subsequent scaling which makes a rough surface. Tests of cores by the department have not so far shown vibrolithic has as small a water absorption as many hand-finished jobs.

GREAT LAKES DIVERSION DISCUSSED

Robert Isham Randolph described the effect of the Chicago diversion upon the levels of the Great Lakes, illustrating his talk with three moving picture reels. So much adverse newspaper criticism has been printed in Wisconsin that the anticipated fireworks following Mr. Randolph's talk were noticeably absent, which would seem to indicate that an engineering basis of agreement should not be hard to reach.

Sewage problems of other cities on Lake Michigan were outlined by T. Chalkley Hatton, and Frank R. King, in a committee report reviewing the development of sewerage systems and sewage disposal in the state; 206 of the former and 74 of the latter.

Recent developments in public utility work were noted by R. H. Pinkley, engineer of way and buildings, of the Milwaukee Electric Railway & Light Co. Three-truck trains of two cars during

the rush hours and one-man cars at off-peak periods, welded joints, concrete pavement, labor-saving tools for track work, electric furnace steel for specials, snow removal for a 33-ft. width to keep vehicles off the rails, were some of the advances in the street railway operation. The successful use of powdered coal in the power plant and utilization of heat to generate steam at gas plants, as well as burning gas instead of coal under the retorts, are recent developments in this field.

Engineers and architects apparently live in harmony in Wisconsin. Grover H. Lippert, architect, described in detail how he and a structural engineer, L. R. Balch, worked out the plans for the New Belmont hotel, which had many restricting conditions both from an engineering and architectural viewpoint. In discussion J. P. Schwada, city engineer, Milwaukee, referred to happy results of co-operation of the engineer and architect of the new Riverside pumping station, but results rather otherwise where an architect had attempted to build a bridge and after bids were in, referred the matter of proper pile design to the engineers. On working over the design $40,000 was saved. Arthur Peabody, state architect, stated that an architect, if kept up-to-date in his own line, had no time to keep up with the latest developments in engineering.

E. J. Potter, architect, described the design and structural features of the Madison Masonic Temple which has a combination steel and concrete frame with numerous unusual connections.

The newly elected officers are as follows: W. G. Kirchoffer, president; A. L. Hillis, vice-president; M. W. Torkelson, new trustee, and Leonard S. Smith, secretary-treasurer.

New Downtown Rapid Transit Plan For Pittsburgh

A proposal for a rapid-transit loop line encircling the downtown triangle of Pittsburgh has been advanced by E. K. Morse and A. H. Burchfield in an address before the Engineers' Society of Western Pennsylvania. The plan provides for a six-track elevated structure along Duquesne Way, on the bank of the Allegheny River, from the Point north to Tenth St., and along the bank of the Monongahela River (Water St.) east to the vicinity of Smithfield St., thence continuing to Grant St. as a three-track elevated structure. Here the line would go into subway, and would extend under Grant St. and the prolongation of Grant St. through the Pennsylvania R.R. yard near the Union Station to Liberty Ave., where it would turn west to join the subway structure near Tenth St. and Duquesne Way.

Within the loop all surface street-car lines would be removed, and the lines reaching the center of the city from all directions would deliver their cars to the loop. In connection with the elevated structures on the two waterside streets a river wall would be built to increase the protection of the lower city from high water. This wall would be substantially on the line proposed a number of years ago by the Pittsburgh Flood Commission.

Railroads to Start Work on New Jersey Belt Line

The Port of New York Authority has announced that the plans for the physical connections and for the interlocking and signal equipment to make possible the operation of the marginal railroad along the New Jersey waterfront at New York as a single operating unit have progressed to the point where the New York Central has allotted $427,000 for the work. This is the largest item of the cost, although other railroads will have some minor construction work to do to make the connections complete. The details of the work are:

Interlocking plant at National Junction for joint use of New York Central and Lehigh Valley	$100,000
Automatic block signals between Weehawken and National Junction	100,000
Interchange tracks with the Pennsylvania R.R. at Harsimus Junction, Jersey City	125,000
Crossover switch from Erie yard	2,000
Enlargement of New York Central yard at Kings Bluff, south of Weehawken	100,000
Total	$427,000

Work will be begun immediately and it is estimated that the interlocking plant and automatic block signals can be completed within six months.

Some Minneapolis Architects Go It Alone

Special Correspondence

The city of Minneapolis is about to erect a municipal auditorium. A building committee was appointed by the auditorium committee of the City Council to select the architect. The Minnesota chapter of the American Institute of Architects asked for a hearing to suggest methods of choosing such an architect. The building committee would not give them a hearing, stating that it was their job to select an architect and they would do so by their own method. They advertised that the architects wanting the job should appear before them on a given date each architect to submit his qualifications. Some fifty architects of the city had petitioned for competition under the rules of the American Institute of Architects but the building committee refused to consider this.

The chapter then called upon all its members to refuse to submit qualifications to the City Council until a hearing was given and a solution of the problem reached. A number of architects not members of the chapter agreed to work with the chapter. When the day came, out of sixty-five architectural firms in the city of Minneapolis only nine submitted their qualifications. Of these nine, four were members of the American Institute of Architects. The chapter still tried to get a hearing on the strength of the small showing but were told "that as these four members didn't see fit to do as the chapter said, the Building Committee guessed that the chapter didn't know what they were talking about" and awarded the contract to one of these firms.

If these four firms had stuck with the chapter the latter would have probably won out and the architect selected with fairness to all of the other members of the profession.

New England Water-Works Men Have Lively Discussion

Engineering News-Record Staff Report

Following two formal papers of a technical character which brought out no discussion beyond a few questions, the New England Water Works Association at its luncheon-meeting in Boston on Feb. 12 had a lively and extended topical discussion on "Why the Applicant Should Pay the Actual Cost of Service Installation from Street Main to Meter." Apparently a majority of the fifteen or twenty cities represented in the discussion charge the entire cost of the connection to the consumer or at least that part of the connection between the street main and the curb. Regardless of how the cost is met, the usual custom and the principle approved by all present seemed to be to have the water-works department supply the material and lay the pipe. A goodly portion of those taking part in the discussion came out strongly for having the cost of the entire length of the service met by the city and put into capital cost of the water-works.

Of the two formal papers, one was "Random Notes on Sanitation in New Hampshire," by Charles P. Pool, sanitary engineer, Division of Water Supplies, Foods and Drugs, New Hampshire State Board of Health. The other paper was by H. W. Clark, chief chemist, Massachusetts Department of Health. Under the title of "Further Studies of Water Purification by Filters Charged with Aluminum or Ferric Hydroxide" Mr. Clark brought down to date the story of what has been done at the Lawrence experiment station along the line indicated in a paper that he read before the association (see *Engineering News-Record*, Sept. 28, 1922, p. 514, for abstract, and Nov. 23, 1922, p. 900, for letter).

At the close of the discussion, Frank J. Gifford, secretary of the association, remarked that there were 134 present at the lunch and that most of the engineers present cleared out immediately after the two formal papers were read, while the old guard of some fifty superintendents stayed on to talk about things of vital interest to them. In view of the fact that the formal papers brought out no discussion, and that the engineers left as soon as the formal papers were read, Mr. Gifford suggested that it would be well hereafter to have technical papers printed in the Journal.

Proposes 443-Mile Ry. in Quebec

The Quebec legislature is being asked to incorporate the Grand Lake Ry. Co., with authorized capital of $2,000,000 and office at Montreal, to build a railway from Bell River, near Amos, Quebec, on the National Transcontinental Ry., 433 miles west of Quebec, to 21 Mile Bay on the Ottawa River, and with power to operate ships on waterways south of the N. T. Ry., between Nottaway and Amos. This proposition is a revival of the Grand Lake Ry. and Transportation Co., which charter was held by the same interests, but has expired.

Differences Hinder Action on Berkeley Fire Lessons

Highly inflammable roofs and inadequate water supply are classed among the preventable causes of the fire that swept 27 blocks of the residential section of Berkeley, Calif., on Sept. 18 (*Engineering News-Record*, Sept. 27, p. 529). Subsequent to a general study of conditions and causes of the fire the city council passed an ordinance prohibiting the use of wood shingle roofs. This action was not wholly acceptable to Berkeley residents, however, and a referendum petition was circulated with the result that there will probably be an election to determine whether this ordinance shall be permitetd to stand. Objectors point out that shingle roofs are not the only inflammable ones and that to prohibit shingles only is to discriminate against that type of construction.

In the matter of water supply, the East Bay Water Co. for several years has had under consideration a plan of main extensions that would improve the inadequate distribution system. Since the fire the city passed an ordinance which was to protect the company's investment in the proposed improvements. This ordinance is now being attacked by referendum.

Bill Proposes Sale of Hoboken Shore Line to Port Authority

A bill to authorize the Secretary of War to sell the Hoboken Shore Line, now constituting part of Belt Line No. 13 of the Port of New York Authority's comprehensive plan for the development of the port, and authorizing that body to acquire the stock of this railroad from the Secretary of War has been introduced into the House of Representatives. The bill also authorizes the Secretary of War to accept in lieu of cash the bonds of the Port Authority when secured by such lien as the Secretary may determine proper, and authorizes the Port Authority to operate the railroad in state and interstate commerce.

Engineers Approve Dismissal of War-Fraud Indictments

The Syracuse section of the American Society of Civil Engineers at its meeting Feb. 15 adopted resolutions approving the decision of Justice Hoehling, of the District of Columbia Supreme Court, in dismissing the indictments against Benedict Crowell and six others charged with fraud in the assignment of cantonment construction contracts. The resolutions were adopted unanimously and a copy sent to the national body recommending that it publish the results of the case "to the end that the public mind be disabused of any impression it may have received from unjust accusation, the stigma of indictment, the fact that charges made against the engineering control of our war construction for the most part reckless and unsustained, and that the specific accusations were untrue."

Changes in California Highway Commission Organization

The California Highway Commission has recently established a new division including the territory between Sacramento and the northern line of Merced County. This is the third division created within the past year.

To co-ordinate the work at headquarters, R. M. Morton, the state highway engineer, has established five major departments to which heads have been assigned as follows: Surveys and plans, Fred J. Grumm, office engineer; construction, C. S. Pope; bridges, H. D. Miller (acting); equipment, R. H. Stalnaker; maintenance, A. J. Wagner.

This reorganization of the commission is expected to result in less wasted effort, greater efficiency and more systematic co-operation and co-ordination among all departments.

The California Highway Commission, which has been functioning as a branch of the State Department of Public Works, is now a separate department.

House Passes Gasoline Tax Bill for District

About $1,000,000 May Be Realized for Improvement and Repair of D. C. Thoroughfares

Washington Correspondence

Further endorsement of the gasoline tax as an equitable method of providing funds for use on roads and streets was had Feb. 11 when the House of Representatives passed a bill proposing to levy two cents a gallon on all motor-vehicle fuel sold within the District of Columbia. The bill also provides for the payment of the regular personal property tax on all automobiles assessed at more than $1,000, and a registration fee of 15 cents per horsepower. It is estimated that this bill will yield $1,000,000 annually, as an exclusive fund for improving and repairing streets and roads within the District.

The fact that Congress has recognized the equity of a gasoline tax and has prescribed that the receipts therefrom must be used only for highway construction and maintenance is expected to serve as an example to those states which as yet have not adopted the gasoline tax, and those which have one but divert part of the funds to other than highway expenditures.

Other Moneys Available

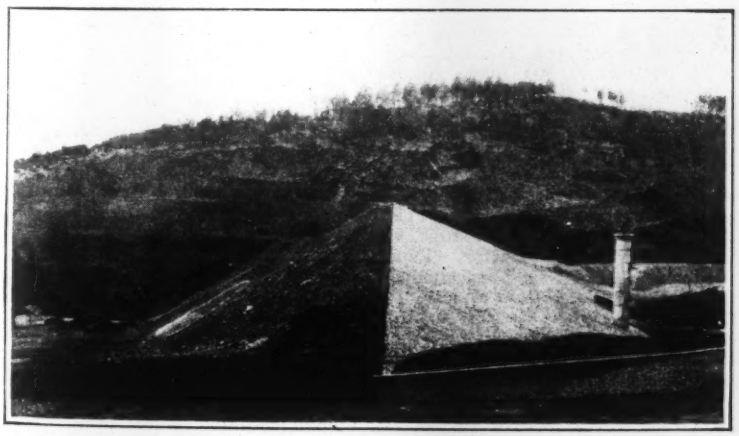
In the District of Columbia, a policy is in effect whereby the federal government pays 40 per cent of district expenditures in lieu of paying taxes on its property and with the idea of expediting the capital's beautification. This will make available additional amounts for highway work, as the federal government's proportion will be in addition to the $1,000,000.

One effect of the legislation will be to remove the serious friction that has existed between Maryland and the District of Columbia. This is the first year that Maryland has recognized the District of Columbia license tags. It also will have the effect of improving the streets and roads of the District of Columbia, which have been in contrast with the uniformly good roads of Maryland, due to the disinclination of Congress to appropriate adequately for that purpose.

Barge Canal Depth Made 12-Ft.

In *Engineering News-Record*, Feb. 7, 1924, p. 229, it was stated that recommendation had been made by D. B. LaDu, state engineer and surveyor of New York, that the New York State barge canal be immediately deepened from Waterford to Utica to a 12-ft. depth. This is not quite correct. The state engineer recommended that the canal be maintained to its full 12-ft. depth and that in order to insure a navigable channel of 12-ft. depth in places, it would be advisable to dredge to an over depth of 2 ft. or a total depth of 14 ft. The barge canal was built with a 12-ft. depth of water and any less depth is due to silting in and deposited material in the channel. Mr. LaDu's recommendations were only to bring about a maintenance of the original 12-ft. depth.

Priest Dam Completed Late in 1923



THE UPSTREAM half of this earth-filled structure on the Hetch Hetchy project was built by hydraulic sluicing methods and the lower half by the dry fill process. The height is about 150 ft. and the material used totals 800,000 cu.yd. The concrete core wall has horizontal joints every 16 ft. and vertical joints every 50 ft. The upstream face has a slope of 2½:1 and the downstream slopes are 1¾:1 and 2:1. Both upstream and downstream faces are paved with riprap, 2 ft. thick on the downstream face, and with thickness on the upstream face varying between 5 and 2 ft.

Minnesota Surveyors Meet

Special Correspondence

The twenty-ninth annual convention of the Minnesota Surveyors and Engineers Society was held at Minneapolis, Feb. 21 and 22, following the annual road school of the state highway commission held in St. Paul, Feb. 20, at which some 200 county and state highway engineers gathered to listen to lectures and talks on road building by Charles M. Babcock, commissioner, and J. H. Mullin, chief engineer, of the highway department.

Outstanding subjects discussed at the Minnesota Surveyors and Engineers convention included an illustrated talk by Frederick Mears, chief engineer, St. Paul Union Depot Co. on the construction of the Alaskan Ry. (under whose direction it was built), a paper by W. E. King of Toltz, King & Day, St. Paul, entitled "To What Extent are Municipal Improvements an Economic Necessity," one by M. E. Chamberlain, "Amendments Necessary to the Minnesota Registration Law," and a paper on "The Proper Height of the Ground-Water Table and its Fluctuations as Influenced by the Soil and Different Methods of Drainage" by Sven Norling.

One day was given up to meetings of the municipal highway, drainage and surveyors' sections. Considerable interest was manifest in surveying, and several worthy papers were read on the importance of accurate surveying records, monumenting, sub-division of sections, the county surveyor's office as now maintained in Minnesota and the importance of the registration law.

So successful has the organization been this year, all officers were re-elected, as follows: C. L. Motl, president; T. H. Curtis, vice-president; and E. G. Briggs, secretary-treasurer.

Undermined Bank Causes Accident at Bridge in Frazer Valley

Following two days of rain in the Frazer River valley in British Columbia an ice jam occurred in the valley of a small stream above the tracks of the Canadian National Rys. and diverted the swollen stream so that it undermined the south side of the railroad enbankment at the west approach to the bridge. The bridge was a four-bent frame trestle.

About 6 a.m. on Feb. 12 the locomotive of a passenger train approaching the bridge from the west at about 30 m.p.h. passed over the undermined track without being derailed but the track settled so much under the weight of the locomotive that the baggage car and the colonist car were derailed. The forward end of the baggage car dropped into the opening washed out behind the end of the bridge and collided with the back of the ballast wall with sufficient force to cause the bridge to buckle and partially collapse. The momentum of the train pushed the baggage car and colonist car off to the north side of the bridge until they came to rest against the east bank of the stream. The locomotive broke loose from the baggage car when the latter derailed and passed over the bridge before it failed. Twenty-three people were injured, none fatally.

Nashville Bridge Repair to Go Forward

The Board of Public Works of Nashville, Tenn., has adopted a resolution setting March 11 as the date for opening bids on the repair of the Sparkman and Jefferson concrete bridges across the Cumberland River, which bridges it will be remembered are showing serious disintegration of the surface concrete, as reported in *Engineering News-Record* several times.

Stream Commission Projects Large Reservoir in Quebec

The development of 15,000 hp. at St. Paul in Berthier County along the St. Lawrence River between Montreal and Quebec will be made possible by the new storage reservoir project of the Quebec Stream Commission on the upper reaches of the Riviere du Loup. The reservoir will have a capacity of 3,500,000,000 cu.ft. The legislature is being asked for authority to spend $300,000 for the dam at the power site and the power will be disposed of to the Quebec Central Power Co. on a rental basis equivalent to 10 per cent of the government's expenditures on the project.

City and Consulting Engineers to Report on Philadelphia Water

Mayor Kendrick has appointed a consulting board of engineers to report upon the most economical and feasible plan for securing an adequate water supply for the City of Philadelphia. Director George H. Biles, of the Department of Public Works, is chairman of the commission. Other members are Alexander Murdoch, chief of the Bureau of Water; Solomon M. Swaab, consulting engineer to the City of Philadelphia; Joseph F. Hasskarl, Philadelphia; and George W. Fuller, J. Waldo Smith and Allen Hazen, New York City.

Messrs. Fuller, Hasskarl, and Smith, together with J. W. Ledoux, Philadelphia, composed the commission of 1920 which investigated the existing facilities at that time, and made recommendations, endorsed by Carleton E. Davis, then chief of the Bureau of Water, for improvements of those facilities and for gradual securing of new sources of supply. (See *Engineering News-Record*, Oct. 14, 1920, p. 290.) After Mr. Davis was succeeded as chief of the Bureau of Water, last June, by Fred E. Dunlap, the latter recommended the changes in plan outlined in *Engineering News-Record*, Feb. 14, p. 290.

The present commission has been directed to investigate all the plans as part of its duties. Appointment of this board is the first step taken by the new city administration toward the provision of a new water supply system. A municipal loan of $6,000,000 for construction of such a system was approved by the voters of Philadelphia at the election in November, 1923. The board will commence work at once, and it is expected that a report will be submitted within three months.

Random Lines

The Tribute of Imitation

Sir—In "City Homes on Country Lanes" by William E. Smythe, Part 2, Chapter 1 is entitled "The Age of the Engineer." I wish I could quote the chapter in full, but a few extracts must suffice. It starts out:

"The World has come to the Age of the Engineer—when engineering is statesmanship and statesmanship is engineering." A little further down we find—". . . and a very large share of the opportunity of rural life, could be traced to the absence of this high sense of engineering . . ."

Still further we read: "Now the man is a scientific engineer in the matter of making salads." To the same paragraph is appended a footnote:

"Shortly after these words were written the Boston Institute of Technology announced a new department of Food Engineering."

"We need a School of Social Engineering."

"We need a type of engineer who will grasp the whole problem of organizing prosperity and happiness for our people on the land."

Such excerpts, of course, give no true picture of the chapter as a whole, but they will serve to give some idea of the author's conception of an engineer.

In Antioch Notes, Feb. 1, 1924, published by Antioch College, Arthur E. Morgan, M. Am. Soc. C. E., president, we find:

"To develop interest, we treat speech as a kind of social engineering."

Evidently, "engineers" and "engineering" are terms with sufficiently favorable connotations to invite their appropriation by persons in unrelated activities. I. B. T.

* * *

But No Pink Giraffes Since Mr. Volstead

According to the annual report of the sanitary bureau of the New York City Department of Health, the following animals were found dead in the city streets during 1922: 254,803 cats, 5,697 horses, 4,538 dogs, 308 cattle, 3 elephants, 3 seals, 1 lion, 1 bear, 1 deer, and 1 alligator.

How some little girl must have wept that night her pet elephant didn't come home.

* * *

Putting the Engineer Where He Belongs

A correspondent has sent in a clipping from a theological magazine which reads as follows:

"The Presbyterian General Board of Education suggests the following as a true order in which to line up different human callings in the order of their importance and claim upon young Christian life and dedication: Ministry, teaching, medicine and nursing, law, farming, business, manufacturing, engineering, etc. The Board admits that others might not agree to this order, but presents it as suggestive and thought-stimulating."

Engineering Societies

Calendar

Annual Meetings

AMERICAN RAILWAY ENGINEERING ASSOCIATION, Chicago, Ill.; Annual Meeting, Chicago, March 11-13, 1924.

NATIONAL CONFERENCE ON CITY PLANNING, New York City; Sixteenth Conference, Los Angeles, Calif., April 7-10, 1924.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York City; Spring Meeting, Atlanta, Ga., April 9-12, 1924.

AMERICAN ASSOCIATION OF ENGINEERS, Chicago, Ill.; Annual Meeting, San Francisco, Calif., June 11-13 1924.

NATIONAL FIRE PROTECTION ASSOCIATION, Boston, Mass.; Annual Meeting, Atlantic City, N. J., May 13-15, 1924.

AMERICAN WATER WORKS ASSOCIATION, New York City; Annual Convention, New York City, May 19-24, 1924.

AMERICAN SOCIETY FOR TESTING MATERIALS, Philadelphia, Pa.; Annual Meeting, Atlantic City, N. J., June 23-28, 1924.

The **Indiana Sanitary and Water Supply Association** will hold its annual convention March 6 and 7 at French Lick. The program includes advertising, financing, plumbing installations, cross-connections, well development, stream pollution, aeration, tastes and a simultaneous presentation of divisional papers on plant management and on water treatment. The first session starts at 2 p.m. C. K. Calvert, Indianapolis, is secretary-treasurer.

The Texas Section, American Society of Civil Engineers, has changed the date of its annual meeting to April 16, 17, and 18, instead of March 20-22 as announced in *Engineering News-Record* under date of Jan. 24.

Personal Notes

G. W. BUCHHOLZ, former executive secretary of the Associated General Contractors of America, and most recently the Eastern manager of the W. M. Sutherland Building & Contracting Co., has entered the construction field independently, his headquarters being at Asheville, N. C. The company he has organized is known as the Buchholz Construction Co. and his firm will undertake general building contracting and construction and engineering jobs. The firm's address is 28 Electrical Building, Asheville, N. C.

JOHN P. WENTWORTH, who has been one of the assistant engineers with Metcalf & Eddy, consulting engineers, Boston, since 1911, has been admitted to the firm as a junior partner. The partnership now consists of Leonard Metcalf, Harrison P. Eddy, Charles W. Sherman, Almon L. Fales, Frank A. Marston and John P. Wentworth.

A. GILLIES has opened an office as consulting engineer, in Queen's Hotel, Trimmins, Ont. Mr. Gillies is a graduate of the University of Toronto. He has been engaged successively as resident engineer for the Cobalt Power Co., Cobalt, Ont., and for the Minnedosa Power Co., Minnedosa, Ont., contractor's engineer on construction of bridges at Fort William for the Canadian Pacific Ry., in surveying work with George A. McCubbin of Chatham, Ont., and municipal work with J. E. Bell of St. Thomas, Ont. Since his overseas service he was for three years on the staff of the St. Mary's Cement Co. and recently in municipal and surveying work with Sutcliffe & Neelands of New Liskeard, Ont.

PERRY K. MILLER, of the firm of Miller & McGiffert, civil engineers and surveyors, Montclair, N. J., has been commissioned a major, in the Engineer Reserve Corps. During the war, Major Miller served eighteen months in France as a reserve officer.

PAUL L. BEAN, consulting and hydraulic engineer, Auburn, Me., has been elected agent of the Androscoggin Reservoir Co., Lewiston, Me., to succeed the late Walter H. Sawyer. It is proposed to have him succeed Mr. Sawyer as agent of Union Water Power Co. also. Mr. Bean is a graduate of the University of Maine, school of engineering. His early experience was in connection with bridge building. During 1914 he was chief engineer of the Maine Public Utilities Committee, and later was one of the firm of Sawyer & Bean, civil engineers.

THE MCKELVEY CONSTRUCTION CO., INC., of St. Louis and New Orleans, announces the establishment of a branch office in the Hammond Building, Detroit, in charge of Homer E. Anderson, vice-president of the company.

JOHN J. NOELL, formerly of the Electrical Company of Delaware at Wilmington, Del., is now in the division of construction and engineering of Stone & Webster, Inc., Boston, Mass., as engineer in the electrical division.

ALBERT S. BLANK, city engineer of Rahway, N. J., has been appointed acting town engineer of Belleville, N. J., following the retirement of Frank T. Shepard. Upon the creation of an engineering department in Belleville, the appointment of Mr. Blank will be made permanent.

GEORGE C. HALWAS, formerly structural engineer with Leroy B. Rothschild, Philadelphia, has been appointed resident engineer of the Bear Mountain bridge over the Hudson River. He assumed his duties there on Feb. 4.

PAUL H. NORCROSS, consulting engineer of Atlanta, Ga., has been elected president of the Chamber of Commerce of that city. He has served Atlanta in many civic capacities, having been one of the Chamber's vice-presidents.

J. C. CARPENTER, senior highway engineer, Bureau of Public Roads, who has been in charge of federal-aid highway work in Virginia for the past five years, has been made assistant district engineer for the Bureau with headquarters at Fort Worth, Texas. Mr. Carpenter, a civil engineering graduate of Iowa State College, was the first president of the Virginia Section of the American Society of Civil Engineers. He was also president of the Richmond chapter of the A.A.E.

Obituary

ROBERT P. SHIELDS, SR., contractor and builder, whose work included the Fort Dearborn building in Chicago, the First National Bank, Masonic Temple and Y. M. C. A. building in San Diego, Calif., died in the latter city Feb. 9, aged 72.

WILLIAM FLINN, of Booth & Flinn, contractors, Pittsburgh and New York, died Feb. 19 at St. Petersburg, Fla. of pneumonia. Mr. Flinn was born in England of Irish parents. As a boy he went to Pittsburgh and first worked as a day laborer. He became a contractor and a partner in the firm of Booth & Flinn, which was one of the builders of the New York subways and more recently contractor in charge of the Hudson vehicular tube.

JOSEPH STRUTHERS, treasurer of United Engineering Society from 1911 and of Engineering Foundation from the organization of its Board in 1915, died at the French Hospital in New York, Feb. 18. Mr. Struthers had been secretary and treasurer of the Engineers' Club of New York since 1909. He was born in New York 58 years ago and was educated in the public schools, College of the City of New York and Columbia School of Mines. He received the degree of Ph.D. from Columbia University in 1895.

PLIMMON H. DUDLEY, consulting engineer to the New York Central R.R. Co. since 1880 and one of the foremost authorities on rail in this country, died at his home in New York on Feb. 25, 1924. An extended biography will be given in a later issue.

JOHN W. KENDRICK, consulting railway engineer and chairman of the International-Great Northern Ry., died in Chicago on Feb. 16. Mr. Kendrick was born at Worcester, Mass., in October, 1853. He began his railway experience in 1879 as levelman in a construction party on the Northern Pacific Ry. and rose rapidly until he became chief engineer of the St. Paul & Northern Pacific Ry. in 1883 and of the Northern Pacific Ry. in 1888. He was made general manager of the latter road in 1893 and vice-president in 1898, resigning in 1901 to go to the Atchison, Topeka & Santa Fe Ry. as vice-president. In 1911 he took up private practice and was consulting engineer for several projects in this country and abroad. His latest work was the physical examination of the property of the International & Great Northern Ry., and its financial reorganization under the present name, as a result of which he was made chairman of the board. Mr. Kendrick was a member of the American Society of Civil Engineers, American Railway Engineering Association, American Society of Mechanical Engineers and Western Society of Engineers.

From the Manufacturer's Point of View

A Point of Contact
Between Maker and User of
Construction Equipment and Materials

To Make Concrete Mixer Standards Effective

Contractors' Support Needed in Carrying Out Program of Joint Committee—Benefits to Equipment Makers and Users Foreseen

By Samuel Shafer
Chief Engineer, Chain Belt Co., Milwaukee

(Paper presented at annual meeting of Associated General Contractors in Chicago, Jan. 21-24, 1924)

TEN or twelve years ago a number of mixer manufacturers, recognizing the chaos of design and nomenclature and the lack of any definite plan for improvement, organized themselves into an association and invited all manufacturers of concrete mixers to become members. The first thing we set out to do was to establish a common language; we discovered that practically every manufacturer had his own method of designating or classifying his machines. A few used the bag rating, numbering their machines on the basis of the number of bags used in mixing a batch of concrete. For instance No. 1, No. 2, etc. Others numbered their machines according to the loose aggregate they were supposed to handle per batch, such as No. 10, No. 15 and No. 18.

History of Early Work

We set out to establish a definite method of measuring and expressing the capacity of concrete mixers and adopted as a standard what is now known as the wet-batch rating. By this is meant that the capacity of the machine is determined by the number of cubic feet of mixed concrete the machine handles in a batch.

Recognizing the fact that it is not advisable to split bags of cement in making a batch of concrete, we adopted as our basis of rating the leanest standard proportion used, 1:3:6. We determined the amount of mixed concrete such proportion would give and adopted this as a standard. The machines were then numbered according to the amount of mixed concrete delivered per batch; the numbers arrived at were 7, 14, 21 and 28. Another size was adopted called the No. 4 which was a half-bag mixer on the above proportion. To differentiate between the side-loader or building mixer and the end-loader or paving mixer, we further adopted the suffix "S" to designate the side-loading mixer and "E" to designate the end-loading paver. This prevented confusion between building mixers and pavers.

The difficulties encountered in getting the standards generally accepted is illustrated by the fact that in the early part of 1918, 29 mixer manufacturers made a report to the War Service Committee. This report showed that there were 30 different sizes of building mixers and 15 different sizes of paving mixers being manufactured and placed on the market. The War Service Committee recommended at that time that the building-mixing program be kept down to 4 sizes and the pavers to 1 size. This was a rather drastic recommendation and probably would be today, but I believe that time will prove the logic of standardizing on fewer sizes of mixers and pavers.

Can Maintain Individuality

One of the biggest bugaboos of standardization, and one that has retarded its progress, is the theory that standardization prevents individual initiative, and that articles manufactured to a standard become cut and hewn to one pattern and do not permit individual initiative. This is an absolute fallacy. There is plenty of room for initiative and every manufacturer can maintain the individuality of his product and still conform to recognized standards in its manufacture.

A Few of the Benefits of Standardization

- Standardization not a curb on individuality.
- Fewer sizes mean lower production costs—and selling prices.
- Guarantees given for capacity of drum, power and strength of shafting and other parts.
- Name-plate a badge of dependability.

Those of you who attended the Road Show this year may remember that 6 paving mixers were exhibited, manufactured by 6 different companies, and there was individuality shown in every one. However, they were all of the same size, 21-E. The benefits derived from standardization are to the advantage of both the contractor who buys the machine and the manufacturer who builds it.

The first cost of standardization to the manufacturer is much larger than you may imagine. In our own case, to abandon the Rex 10-E paver or any other size of paver, which we will do to conform to the A.G.C. standards, we throw away, so to speak, an investment of many thousands of dollars. Not only this, but in eliminating two sizes a manufacturer, in order to build the recommended sizes, must bring out a new machine at a designing cost of many thousands of dollars. Then there is the question of replacement parts for obsolete machines that must be carried by the manufacturer at considerable expense.

Concentrate on Few Sizes

The elimination of several sizes and concentration on a few which meet the demand of the majority of contractors reacts to the benefit of the manufacturer, because he can concentrate on a few sizes of machines that can be turned out in quantities. This large quantity production will automatically cut down the cost of manufacture for the simple reason that on a quantity production basis capital can be invested in special tools and shop equipment. The maker can also buy his raw material in much larger quantities, which all goes to cut down costs. This reacts to the benefit of the contractor, because lower production cost means lower prices to the consumer. If you have an excavating job of 150 cu.yd., it is going to cost you more per cubic yard to move that excavation than it would if you had an excavation of 150,000 cu.yd. In one instance you would use a few men with shovels and in the other you would tool up and develop an efficient organization. It is the same with the manufacture of concrete mixers or any other product.

I recently noticed an article in one of the current magazines on what has been done in the standardization of automobiles. There are 112 different makes of motor cars manufactured in the United States, each car having between 3,000 and 4,000 parts. According to a survey made by the Standardization Department of the Society of Automotive Engineers, manufacturers participating in the standardization work of the society saved on an average of 15 per cent of their gross sales during 1921, equivalent to about $750,000,000. A part of this sum appeared in the form of increased dividends, but the largest part was passed on to the car owner in the form of reduced prices. The same principle could be applied to concrete mixers by properly standardizing them and contractors would benefit by the reduced prices.

Just imagine, when buying a mixer or paver, that you could depend upon the machine having a drum which would mix efficiently a standard volume of aggregate, that its power was guaranteed to be according to a definite standard, that the shafting and keys would be of a size to give the equipment definite strength, that even the tools and accessories furnished had been approved by a committee after study of the contractor's needs for tools. Tools are relatively small items, but do you realize what it means to have a standard tool equipment for all mixers?

Joint Committee's Work

The A.G.C. has appointed a Joint Committee on Construction Equipment, which has called many meetings of manufacturers of concrete mixers and pavers. The result of these meetings is a definite plan of standardization to benefit the contractor and manufacturer. The concrete mixer manufacturers have appointed what is called a "manufacturers' committee" to work

High-Voltage Equipment Ordered for Pit River Station

The Mount Shasta Power Corporation, a subsidiary of the Pacific Gas & Electric Co. has placed with the Westinghouse Electric & Manufacturing Co. an order amounting to nearly $400,000 for ten 9,000 kva. transformers and five circuit-breakers for 220,000-volt service. The transformers are designed to step down from 220,000 volts to 11,000 volts.

The voltage of 220,000, for which this equipment is designed is the highest that has yet been attempted for power transmission. Special taps will be provided in the transformers for operation at a lower voltage at the time of installation, but, as the load on the line increases, the transformers will be connected for 220,000 volts. The apparatus, which is to be installed in the new Pit River No. 3 generating station on the Pit River in California, will be used to increase the capacity of the power company's system.

(*Concluded from p.* 382)

with the joint committee of the A.G.C. on construction equipment. This committee will consider the different parts entering into the manufacture of the machine and standardize on the unit of power, the water-measuring unit, shafting, keys, safety devices, etc.

A program of standardization sponsored by the A.G.C. cannot be accomplished by the manufacturers alone. We will have to depend upon members of the A.G.C. to help by supporting the movement. The joint committee on construction and equipment has adopted a name-plate which all manufacturers conforming to the A.G.C. standards will be permitted to use on their machines.

Contractor's Support Needed

Contractors can further help by recognizing the approved standards, purchasing machines which conform to them and which carry a name-plate bearing the approval of the A.G.C. Standardization will eliminate any question between the manufacturer, contractor and salesman, as to the capacity of a concrete mixer purchased. You will know absolutely that a machine will mix the size of batch indicated on the name-plate. If it does not, the manufacturer is going to give you a machine that will, because he knows the power of your organization, and further knows that if the machine does not conform to your standards he cannot use a name-plate bearing your approval.

The A.G.C. has labored long and hard to make this standardization work effective. C. E. Bement, representing the manufacturers, has given much of his time to this movement. Other manufacturers have co-operated, but the question of how to make concrete mixer standards effective is very largely up to each member of the A.G.C., and up to the A.G.C. as an organization to acquaint each of its members with this work, to enlist their support and to interest the smaller contractors outside the organization in the value of this work to them.

Plans Drafted for Manufacturers' Bureau of A. G. C.

Suggestions for the operation of the proposed Manufacturers' Bureau of the Associated General Contractors, initiated at a joint meeting in Chicago Jan. 18 between the contractors and manufacturers of construction equipment, are requested by the A. G. C. through a committee consisting of Brig.-Gen. R. C. Marshall, Jr., and F. L. Cranford, working in co-operation with a committee of manufacturers headed by C. E. Bement, vice-president and general manager of the Novo Engine Co. Tentative plans for the bureau have been drafted and are being submitted in printed form to the equipment makers.

As outlined in the proofs being distributed for criticism the proposed new bureau of the Associated General Contractors would serve as a clearing house for ideas among equipment manufacturers and their customers, the contractors, and the manufacturers themselves. Standardization of specifications for construction machinery and equipment would form a large part of the work. Collection and distribution of trade statistics also would be included among the functions of the proposed bureau, the statistics to be published in the established engineering and trade journals, with possibly a special section devoted to this purpose in the publication of the A. G. C.

Subdivisions Contemplated

The present organization contemplates a sub-division of the bureau's work into several divisions, such as a mixer manufacturers' division, a power bucket division, a steam shovel division and others, the purpose being to expedite for each group such work as it alone may request.

It is conceivable for example that the mixer manufacturers may desire to continue with their standardization measures already inaugurated, that some other division may desire to take up trade practices and yet another the gathering of statistical information. In the handling of some matters it may be advantageous for two or more groups to act jointly. In any event it is necessary to ascertain from the different manufacturers what activities each group desires to carry on and then to devise the means for doing it most effectively. The engineering and investigation department of the A. G. C. will be placed at the disposal of the bureau.

Disseminating Information

What medium will be used for the dissemination of information and exchange of ideas, other than the established trade press channels has not been determined, though a number of manufacturers have asked that a section devoted to this matter be added to the official magazine of the contractors' association. Also it is proposed that each manufacturer associated with the bureau be listed in this section under the proper division. If the manufacturers favor this procedure the A. G. C. will comply with the request.

At the Chicago meeting a sufficient number of companies, to make the new bureau a success, signified their intention of participating in its establishment. The foundation of the undertaking is therefore being prepared.

Manufacturers of any line of construction equipment or materials who desire to associate themselves with divisions of the new bureau are requested to communicate with the Associated General Contractors, Munsey Building, Washington, D. C. Suggestions pertaining to problems that should be taken up by any division will be appreciated, especially any matters of trade practices relating to contractors or any matters in which the experience of general contractors may be of assistance to the manufacturer.

J. E. Moss Iron Works Acquires Riverside Bridge Co.

By action of its stockholders Jan. 31 the J. E. Moss Iron Works, Wheeling, W. Va., has acquired the interests of the Riverside Bridge Co. The Riverside works were founded by Nelson P. Whitaker at Martins Ferry, Ohio, in 1902. The Moss company was founded in 1909 by J. E. Moss and acquired the Architectural Iron & Wire Works in 1916. The consolidated Moss and Riverside organization, in addition to its output of fabricated steel, will produce ornamental iron and bronze. The officers of the enlarged company are: J. E. Moss, president; R. R. Kitchen, vice-president; F. G. Jolliffe, secretary; J. H. Lesch, general manager; C. Earl Crook, chief estimator; and George E. Seibert, chief engineer. The company employs about 500 workmen.

Business Notes

Parsons Co., Newton, Ia., manufacturer of trench excavating machines, announces the election of James McElroy as vice-president of the company, with headquarters at 11 South La Salle St., Chicago.

Novo Engine Co., Lansing, Mich., announces the appointment of three new distributors: Dixie Machinery Co., Shreveport, La.; Wylie Bros., Oklahoma City, Okla.; and H. L. Boardman y Cia, Saltillo, Coahuila, Mexico.

Didect Oxidation Disposal Corporation, Philadelphia, announces the dissolution, as of Nov. 30, 1923, of its relations with H. Jerome Hirst, formerly the company's vice-president and general manager.

Linde Air Products Co., New York, manufacturer of oxygen for welding and cutting metals, announces the appointment of Robert W. White, formerly assistant general sales manager, to the position of general sales manager of the Carbide & Carbon Chemicals Corporation, L. M. Zimmer, Western sales manager of the Linde company, has been appointed assistant general sales manager of that organization to succeed Mr. White. Other changes in the Linde personnel include the appointment of E. E. Radcliffe as assistant sales manager, Eastern division, New York; Herman Ullmer,

assistant sales manager, Western division, Chicago; and F. E. Stoppenbach, district sales manager, New York district.

H. H. ROBERTSON CO., Pittsburgh, manufacturer of asbestos-protected metal, skylights, ventilators, mineral rubber and special asphalts, has announced the appointment of James S. Ervin, formerly in charge of the sale of mineral rubber and special asphalts, as manager of sales, with headquarters at Pittsburgh, Pa., to succeed C. D. Mercer, who has resigned from the company.

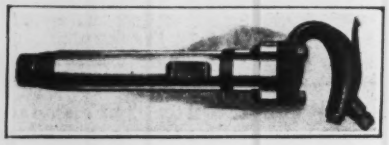
MASSILLON STEEL JOIST CO., Massillon, Ohio, announces the appointment of H. M. Bringhurst as representative in the Chicago territory, with offices at 208 S. La Salle St., Chicago. The company manufactures a steel bar joist for fireproof floor construction.

Equipment and Materials

Pneumatic Riveting Hammer Has Bolted Handle

Bolted handle construction is one of the features of the Ingersoll-Rand Co.'s latest type of pneumatic riveting hammer manufactured in three styles and a range of sizes from 5 to 9-in. stroke. Three alloy steel bolts, fitted with lock washers, hold the handle to the barrel, so that the machine may be readily taken apart for inspection or cleaning with the aid of only a wrench.

These hammers are designed for use with ½-in. hose, have a piston diameter



of 1⅛ in., an overall length of from 16½ to 21½ in., and a weight of from 18½ to 24 lb. They are designed to drive rivets from ¾ to 1¼ in. in diameter.

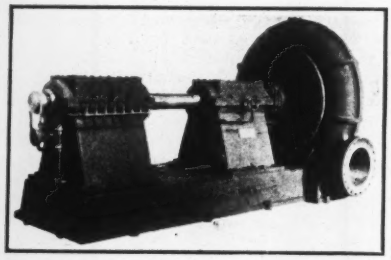
The throttle valve is a combination of the piston and poppet types for which the manufacturer claims the nicety of control of the piston valve combined with the freedom from leakage of the poppet type. The exhaust is through the side of the barrel near the handle and can be deflected in any direction desired by the operator.

New Design of Dredge Pump

A new design of 18-in. sand and gravel dredging pump, weighing 15 tons and operated by a 500-hp. Diesel engine, has recently been developed by the Erie Pump & Engine Works, Medina, N. Y. The impeller is designed to handle 9,500 gal. per minute of water and sand, or approximately from 280 to 300 cu.yd. of sand per hour, against a maximum head of 95 ft. which includes the friction head in 1,650 ft. of 18-in. discharge pipe line.

As shown in the accompanying illustration the pump has a low horizontal discharge, which makes it possible for the pipe line to be placed on the ground or on pontoons without special supports, as is the case when the discharge is from the upper part of the pump shell.

The manufacturer points out that all wearing parts on this pump are made



not only to withstand the severe test of dredging work, but are arranged for quickly renewing worn parts. The shaft and the main and marine thrust bearings are all oversize and are equipped for forced-feed oil lubrication. The shell is extra heavy, the outer rim being reinforced with longitudinal and transverse ribs. Both heads have removable head plates and the suction head has a removable bushing. The glands are of the dual type, split horizontally, and the water seal ring is cast integral with the inner split stuffing box.

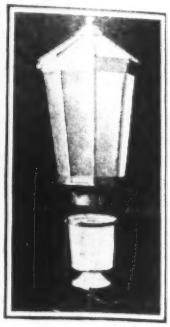
The forced-feed lubrication involves the use of an oil pump belted to the dredge pump shaft, insuring positive drive. The marine thrust bearing is water-cooled and furnished with adjusting nuts for taking up slight wear caused by end thrust on the shafts.

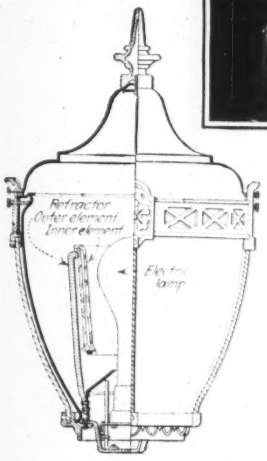
One of these pumps has been purchased by the Inland Dredging Corporation, Brooklyn, N. Y., and is in service at Long Beach, Long Island, N. Y., pumping sand out of the harbor to the shore and filling in low, marshy land for real-estate development.

Refractor for Street Lighting Increases Illumination

A new refractor, known as the Bi-Lux, designed to increase the effective illumination from street lighting units approximately 70 per cent as compared with the most efficient units now in service, has been developed by the Westinghouse Electric & Manufacturing Co. in co-operation with the Holophane Glass Co. Tests made by the Electrical Testing Laboratories of New York show that a 400-cp. lamp within the refractor enclosed within a Westinghouse clear rectilinear glass globe will deliver 2,000 cp. up and down the street, 425 cp. across the roadway at right angles to the curb line, and 250 cp. across the sidewalk. Advantages claimed for this method of "spraying" the light are that the street is evenly illuminated over its entire surface and that there is no glare in the eyes of motorists or pedestrians. With the new refractor part of the light is bent away from the sidewalk and roadway and is built up in directions up and down the street between the posts, where formerly dark zones existed.

The refractor is mounted inside the globe of the lighting [unit] which surrounds the lamp. It consists of two cylindrical pieces of prismatic glass nested one within the other and clamped together so as to form a single unit, the shape of which is a frustum of a hollow cone. The inside surface of the inner element and the outside surface of the outer element are smooth so that in the assembled unit the exterior surface is easily cleaned. On the outside surface of the inner element are vertical prisms which bend the intercepted light downward. On the inner surface of the outer element are horizontal prisms which function to bend the intercepted light into two main beams which





are directed up and down the street at angles of 22½ deg. from the curb line. A minimum beam is deflected to strike the sidewalk at an angle of 90 deg. with the curb line, and a beam of slightly higher intensity is directed in the opposite direction across the roadway.

Publications from the Construction Industry

Gypsum Floor and Roof System—KEYSTONE GYPSUM FIREPROOFING CORPORATION, New York, in a 52-p. pamphlet illustrated with drawings and photographs, describes its Metropolitan system of fireproof floor and roof construction. In this system a monolithic gypsum slab is cast with the use of forms around galvanized wire cables spaced 1 to 3 in. apart and anchored to the frame of the building on the principle of a suspension bridge. The composition of calcined gypsum and wood planer chips sets so rapidly that forms may be removed one hour after casting. For the engineer or architect the pamphlet contains some useful information, with line drawings, on the application of this form of roof or floor to a variety of industrial, commercial, and residential layouts. A minimum thickness of 3 in. is specified, giving a slab weighing 5 lb. per square foot.

Business Side of Construction

FACTS AND EVENTS THAT AFFECT COST AND VOLUME

Value of 1923 Sewer Awards Heaviest Since 1918

Statistics compiled by *Engineering News-Record* on sewer awards of $25,000 and over show that the year 1923 completed a larger money value of contracts awarded than any of the five preceding years. The South is the only section that fell short of the 1922 record. The comparison of the years 1922 and 1923 shows the graphs of the two following the same general trend. The year 1923 for the entire country had its peaks in August and September. This is due to the fact that four of the six sections had their greatest period of sewer construction coming in September, while the Middle West had another peak in the month of August.

In 1922, there were 427 awards totaling $43,584,000 with an average of $102,070 compared with 469 awards of 1923 valued at $66,905,000 and averaging $142,631.

According to geographic sections the sewer construction situation for 1922 and 1923 has been as indicated in the following table of awards and money value:

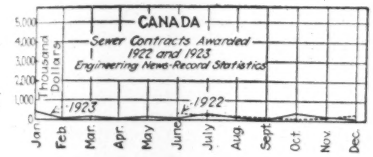
	1922		1923	
	No.	Value	No.	Value
New England	8	$653,000	13	$727,000
Mid. Atlantic	105	10,608,000	110	15,837,000
Southern.....	40	4,125,000	36	3,965,000
Middle West..	142	18,286,000	144	31,680,000
West of Miss.	96	6,785,000	120	8,343,000
Western.....	36	3,127,000	46	6,353,000
Total.....	427	$43,584,000	469	$66,905,000

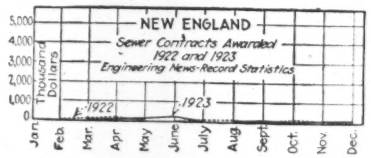
Another numerical comparison of the two years, 1922 and 1923, based upon the natural divisions that this work comes under in its progressive stages as recorded in Construction News, follows:

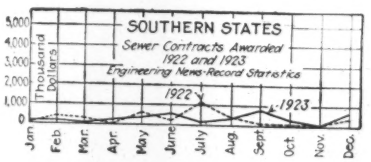
Year	Proposed Work	Bids Desired	Bids Received	Contracts Let No.	Contracts Let Value
1923	709	498	216	469	$66,905,000
1922	601	475	165	427	43,584,000
1923 gain	108	23	51	42	$23,321,000

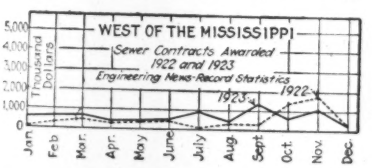
The trend of sewer work from January, 1924, up to, and including February 21 is shown in the following tabulation:

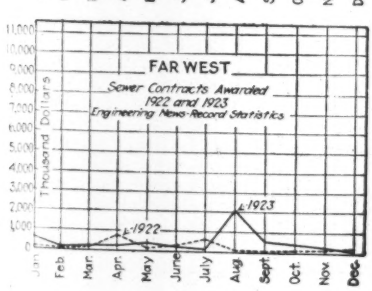
	No.	Value
Proposed work.....	175	$29,435,000
Bids desired.....	59	3,946,000
Bids received.....	25	4,943,000
Contracts let.....	63	6,938,000

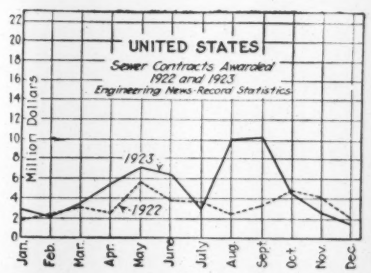


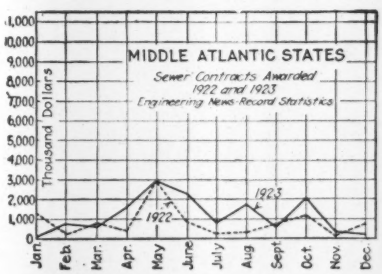


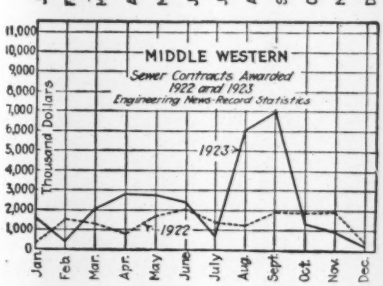












Bids Wanted on Big Jobs

Among the projects on which bids are either asked or will soon be called for, in Construction News, pp. 109 to 121, are the following:

Power Plant, Lake Cushman, Wash., City of Tacoma, takes bids for first unit, $5,250,000.

Club, Chicago, Ill., Lake Shore Athletic Club, $3,000,000.

Ontario, Highway improvement, Total $1,480,000.

Hospital, St. Louis, Mo., St. Louis Mullanphy Hospital, $1,000,000.

High School, Johnstown, Pa., Bd. of Directors, $1,000,000.

Sewage treatment works, Chicago, Ill., Mar. 6, by The Sanitary District of Chicago for equipment for the North Side Sewage Treatment Works, thirty thickener mechanisms complete; three 60 x 96-in. sluice gates, one hundred and forty-four 15 x 15-in. sluice gates and six 8-in. circular sluice gates; 54,000, 1½-in. aeration plates, 4,500, 1-in. plates, three 84-in. sewage meters, thirty-six 30-in. sewage meters, thirty-six 16-in. air meters, three 8-in. air meters, three 6-in. air meters; fine screens with ⅛-in. mesh to handle 425 sec.-ft., with a loss of head not to exceed 6 in., plus one extra unit. Three types of screens are noted as alternates, Dorr, Link Belt and Reinsch-Wurl.

Large Contracts Let During Week

Among the week's announcements of contracts awarded in Construction News, pp. 109 to 121, are the following:

Power Plant, Long Beach, Calif., Southern California Edison Co., $8,000,000, to Stone & Webster, San Francisco.

Railroad, Florida, Western & Northern Ry. Co., 205 miles, $4,000,000, to Jefferson Constr. Co., Charleston, S. C.

Warehouse, Long Island City, N. Y., Ludwig Bauman & Co., $1,500,000, to G. Richard Davis, New York City.

Lock, Uniontown, Ky., Hired labor, $1,500,000.

Paving, Dallas, Tex., Divided into a number of contracts, Total, $1,235,095.

Grain Elevator, Ft. Worth, Tex., Kimbell Milling Co., to Jones Hettelsater Constr. Co., $1,000,000.

Office, Oklahoma City, Okla., to Reinhart & Donovan, $1,000,000.

Sewer, Milwaukee, Wis., to H. Hohensee, $273,229.

Steel Outlook Good

With operations in the steel mills at about 94 per cent of capacity, the present rate of steel ingot production represents the highest attained since June, 1923 and is only 3 per cent under May, the high point of last year.

The January steel ingot output gained 3 per cent over the month preceding and unfilled orders on books of the U. S. Steel Corporation, Jan. 31,

1924, increased 8 per cent over those on hand Dec. 31, 1923.

This increase in production is not only stimulated by a constantly enlarging demand, particularly from railroads, but by confidence in the general business outlook, as shown by the following statement of the National City Bank of New York in its February survey of conditions:

"The United States Steel Corporation in 1923 had the year of largest output and earnings since the war, and after adding 25 cents a share to the last quarterly dividend for that year ventured to add 50 cents for the first quarter of 1924. Both are classed as extras, but there is a good deal of confidence that they signify a permanent advance over the regular 5 per cent per annum heretofore maintained, and that the additional distribution would not have been made if the management had not believed the general business outlook to be good."

Fabricated structural steel sales during January, however, were nearly 6 per cent under the preceding month, according to the U. S. Department of Commerce.

Cost Per Mile of Canadian Roads

An idea of the average cost per mile of different types of Canadian roads may be gained from the accompanying tabulation. The figures given are for standard roads of the Provincial Highways System; cost of smaller, "local" road being proportionally lower:

Width in Ft.	Type of Surface	Average Cost per Mile
22	Improved earth road	$2,000 to $2,500
20	Gravel road	6,000 to 7,000
16	Oiled, water-bound macadam	12,000 to 14,000
16	Bituminous macadam	20,000 to 22,000
16	Concrete	25,000 to 30,000

Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

Valuable suggestions on costs of work can be had by noting actual biddings as reported in our Construction News section.

The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of Feb. 7; the next, on Mar. 6.

	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Steel Products:									
Structural shapes, 100 lb.	$3.64	$4.00	$4.40	$3.30	$3.55	$4.20	$3.60	$3.85	$4.25
Structural rivets, 100 lb.	4.40	4.75	4.90	3.75	4.00	5.15	5.00	4.05	6.00
Reinforcing bars, ¾ in. up, 100 lb.	3.54	3.50	3.38	3.20	3.45	3.85	3.65	4.25	3.90
Steel pipe, black, 2½ to 6 in. lap, discount	44%	53.2%	43%	47%	55.05%	36%	37.10@47.40%	45%	47.43
Cast-iron pipe, 6 in. and over, ton	61.60@63.60	56.00	61.00	57.20@60.20	61.50	69.00	+60.00	62.00	60.00
Concreting Material:									
Cement without bags, bbl.	2.50@2.60	2.35	2.05	2.20	2.42	2.84	2.61	2.90	2.72
Gravel, ¾ in., cu.yd.	2.00	2.00	2.38	2.00	1.85	1.90	2.15	1.50	1.50
Sand, cu.yd.	1.25	1.42	2.00	2.00	1.25@1.50	1.00	1.50	1.50	1.25
Crushed stone, ¾ in., cu.yd.	1.85	2.00	2.83	2.00	2.00	3.50	2.15	3.00	1.90
Miscellaneous:									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft.	62.00	40.00	54.75	58.00	—42.75@44.00	.52@.57	36.00	29.00	65.00
Lime, finishing, hydrated, ton	18.20	22.50	20.00	20.00	25.50	24.00	22.00	24.00	21.00
Lime common, lump, per bbl.	3.00@3.25	1.65	1.85	1.50	1.50	2.70	2.10	2.80	9.50
Common brick, delivered, 1,000	23.65@25.85	12.00	11.60	11.00	16@18	12.00	15.50	15.00	17.50
Hollow building tile, 4x12x12, per block	Not used	.10	.11	.064	.075	.065	.....	.11	.115
Hollow partition tile 4x12x12, per block	.1179	.10	.11	.....	.....	.065	.108	.11	.....
Linseed oil, raw, 5 bbl. lots, gal.	.97	+1.05	1.10	.94	+1.07	1.15	+1.07	1.15	1.18
Common Labor:									
Common labor, union, hour	.75	.35	.....	.....	.....	.50@.55	.55	.62½	.....
Common labor, non-union, hour	....	.30	.30@.50	.82½	.40@.45	.35@.50	.50	.62½	.25

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or — signs. For steel pipe, the prevailing discount from list price is given: 45-5% means a discount of 45 and 5 per cent.

New York quotations delivered, except sand, gravel and crushed stone, alongside dock; common lump lime, in 280-lb. bbl. net, and hydrated lime f.o.b. cars; tile "on trucks"; linseed oil and cast-iron pipe f.o.b.

Labor—Concrete laborers' rate, 93¾c.; building laborers (pick and shovel men) 75c. per hr.

Chicago quotes hydrated lime in 50-lb. bags; common lump lime per 180-lb. net. Lumber delivered on job.

Minneapolis quotes on fir instead of pine. Brick, sand and hollow tile delivered. Cement on cars. Gravel and crushed stone quoted at pit. We quote on brown lime per 180-lb. net; white is $1.80 for Kelly Island and $1.70 for Sheboygan. Common labor not organized.

Denver quotes on fir instead of pine. Cement "on tracks"; gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered, in iron bbl. Common lump lime per 180-lb. net.

Atlanta quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net.

Dallas quotes lime per 180-lb. bbl. Steel, cement, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered.

San Francisco quotes on Heath tile, size 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to dealers in yards at San Francisco, for No. 1 fir, common.

Seattle quotes on Douglas fir (delivered) instead of pine. Lump finishing lime per 180-lb. net. Hollow building tile delivered. Hydrated lime in paper sacks. Sand and gravel at bunkers.

Montreal quotes on Douglas fir instead of pine. Sand, stone, gravel and lump lime per ton. Cement, lime and tile are delivered; sand, gravel and stone on siding; brick f.o.b. plant; steel and pipe at warehouse. Hollow tile per ft. Cement price is in Canadian funds (the Canadian dollar stands at 96.61). Bag charge is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net; 3-in., $47.43; 6-in. $119.

Weekly Review of the Market

A comparison of current building materials prices with those of the corresponding period in 1923, shows higher levels for brick, steel, sand and several other factors affecting cost.

The prices of pine timbers and linseed oil, particularly in the New York market, are somewhat below those prevailing in the last week of February, 1923. Cement and gravel, however, seem to have remained approximately at the 1923 levels.

Steel, lumber, sand, gravel, linseed oil and common labor are all considerably below the 1920 peak, which occurred in June of that year. Cement, in a representative market such as that of Chicago, is 2 per cent higher than the 1920 peak, while common brick in New York are 17 per cent above.

Therefore, the immediate outlook of the building materials market is one of continually advancing prices commensurate with the increasing demand, but with the price level at least 12 per cent above a year ago and only 20 per cent under the prohibitive 1920 peak.

Adequate winter reserves will probably avert the usual spring brick shortage in New York. Pine lumber, however, is slightly scarcer owing to unusual winter demand and adverse cutting conditions.

Telegraphic reports to *Engineering News-Record* from the Seattle district, indicate that the fir lumber producers in that section of the country look to the Atlantic seaboard for a market, since the California district is reported overstocked; railroad buying appears practically finished and production is still above normal.